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COST OF PRODUCING FARM CROPS IN THE PRAIRIE PROVINCES

BY

E. S. HOPKINS, J. M. ARMSTRONG AND H. D. MITCHELL

DIVISION OF FIELD HUSBANDRY
DOMINION EXPERIMENTAL FARMS

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In 1931 there were 25,353,000 acres of wheat in the three Prairie Provinces. The Dominion Experimental Farms are conducting experimental work in order to learn the most effective means of reducing the cost of producing this wheat.

COST OF PRODUCING FARM CROPS IN THE PRAIRIE PROVINCES

By E. S. Hopkins, J. M. Armstrong, and H. D. Mitchell

THE OBJECT OF COST OF PRODUCTION STUDIES

The chief reasons for making a study of the cost of producing crops are to discover the most improved methods of reducing the cost and to learn what crops give the most profitable returns. In view of the increasing difficulty of operating a farm profitably, every effort should be made to study all phases of the business which offer any prospect of contributing towards greater success. Conditions change even over a period of a few years necessitating continual changes in farming methods. Farmers are subjected to intense competition from all parts of the world and having no control over the sale price of their products, must utilize every means to reduce the cost of production.

The Dominion Experimental Farms have kept careful records over a long period of years of the various items of expense incurred in the production of different farm crops. Accurate data are available also showing the exact yields of these crops. It is thought that the publication of this material would prove of some interest and value in showing what yields of different crops may be expected and at what cost they are produced. As grain crops constitute 90 per cent of the cropped area in the Prairie Provinces, emphasis has been devoted more particularly to them and especially to wheat. In order to supplement the information secured on the Dominion Experimental Farms and Illustration Stations, a survey was made of the methods and costs of production on a number of representative private farms.

In view of the increasing importance of large labour saving machinery, considerable information has been presented on the comparative cost and operation of these machines. Much of this information has been obtained by the questionnaire method from representative farmers throughout the Prairie Provinces. The authors are very much indebted to those who have so kindly contributed information to the various surveys conducted by the Dominion Experimental Farms, many having gone to considerable trouble in order to supply the most complete details. Data are presented in regard to the farm tractor showing its cost of operation, acreages covered per day and how it compares with horses. The combined reaper-thresher is compared with the binder and thresher method of harvesting grain. The estimated length of life of various farm machines is given as well as the acreages which they normally cover per ten-hour day. Accurate information on these points has a very direct bearing in indicating improved methods of farm organization and in effecting more satisfactory financial returns.

HOW TO CALCULATE THE COST OF PRODUCING CROPS

In calculating the cost of producing farm crops it is necessary to estimate the value of all the various items which enter into the cost, such as the expense for land, machinery, man labour, horse labour, seed, twine and any other expense. Some of these items, such as those relating to the cost of manual and horse labour, are very easily figured because in these instances it is possible to

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record exactly the number of hours worked on the various crops, and then multiply this by the cost per hour of this labour. With other items, however, such as the proportion of the cost of summer-fallow, it is necessary to make an assumption in regard to what share of the total cost should be charged to each crop in the rotation. It may be of interest to explain the various methods used to calculate the different items of expense as an aid to those persons interested in estimating the cost of production on their own farms. In this regard, some changes in method may be found necessary to meet the needs of individual cases. For this reason, the details of the methods used in this bulletin are set forth so that anyone desiring to alter the method or recalculate the data in some other way, may do so.

Items of Expense

USE OF LAND

One important item in the cost of producing crops is that of the use of the land on which the crops are grown. Several methods may be used to calculate this charge.

The method used in this section of the bulletin consists in multiplying the value of the land per acre by the current rate of interest as obtained on first mortgages and then adding the upkeep and taxes. The value of the land per acre may be obtained by dividing the total value of the farm by the total number of acres in the farm. The total amount of taxes is also divided by the total acreage in the farm. This method of determining the charge for the use of the land has the advantage of being very simple but it is applicable only to general farms and does not give absolutely accurate results. It is obvious that by taking account only of the total number of acres in the farm, rather than of the acres under cultivation, the value of the cultivated land may be too low. Furthermore by not charging against the live stock a part of the cost of the barns, another error arises, in this case the figure tending to be too high. However, under average conditions these factors tend to balance each other. Moreover, as this method is applied only to general farm conditions where there are few large investments in specialized buildings and a relatively large area used for crops, these errors tend to become reduced to a minimum.

An alternative method of estimating the value of the land may be used where circumstances such as a large area of waste land and the growing of one specialized crop prevail. Under such circumstances it is evident that the value of the cropped land per acre greatly exceeds that of the wild or waste land. Under these conditions the value of the crop land per acre may be obtained by subtracting the value of the waste land from the total value of the farm and dividing the result by the number of cultivated acres in the farm. The figure arrived at represents the value per acre of crop land. To this must be added the cost of upkeep and taxes in order to determine the total charge for the use of land.

If it is desired to secure more accurate figures on the charge for the use of land the following somewhat more complicated system may be adopted. Where a farm is rented it is necessary to subtract from the total amount of the rent, or value of the crop share, an estimated figure for the use of uncropped land. The remainder is divided by the number of acres under cultivation, giving the charge for the use of the land under cultivation. Where a farm is owned, its value should be divided into separate items such as cultivated land, permanent pasture, waste land, house, barn, and other buildings. The sum of these values, it is clear, should not exceed the sale value of the farm as a whole. The total value of cultivated land is then divided by the number of acres under cultivation, thus giving the value per acre of cultivated land. The charge per acre for

the use of land is then obtained by multiplying this value per acre by the current rate of interest on first mortgages. To this amount must be added the proper proportion of upkeep and taxes and one-half the cost of the use of the barn. As the barn is used to store feed and house stock, it is necessary to charge one-half the cost to each. The annual cost of buildings includes depreciation, interest and upkeep.

It is rather difficult to make a proper valuation for the use of the barn and other buildings and it is frequently necessary to use a figure which is much below their real cost or the amount it would require to replace them. If there is too high an investment in the buildings for the size of the farm, the excess value cannot be used, as it would not increase the value of the farm above that of other farms having a smaller investment in buildings. No charge is made against crops in this method for the use of the house for the reason that it is used as a residence and has nothing to do, directly at any rate, with the income from the farm.

The average charge for the use of the land on each Dominion Experimental Farm in the prairie provinces from 1923 to 1930, inclusive, is given in the following table. This charge represents seven per cent of the estimated value of the land, plus 36 cents per acre for taxes.

TABLE 1.—Average Charge for Use of Land—Dominion Experimental Farms (1923-1930)

Farm	Charge for use of land per acre	Value of land per acre
	$	$
Morden	4 00	52 02
Brandon	4 00	52 02
Indian Head	3 77	48 72
Rosthern	3 00	37 73
Scott	2 80	34 88
Swift Current	2 70	33 44
Lethbridge	2 50	30 58
Lacombe	4 00	52 02
Average	3 35	42 68

MANUAL LABOUR

The rate for manual labour should be the prevailing summer wages in the district for hired help, plus the value of board and lodging. In this section of the bulletin the rate for manual labour has been charged at 25 cents per hour. This represents the prevailing monthly rate for the period from 1923 to 1930 inclusive, plus board and lodging, calculated on the basis of 26 working days per month.

The hours of manual labour used in arriving at the cost of this item, represent only the actual time spent directly in productive labour in the growing of these crops, and do not include time spent in making roads, fencing and other related work from which the crops would indirectly derive some benefit.

HORSE LABOUR

The rate per hour for horse labour may be computed by figuring the total annual charge for keeping a horse and dividing this by the total number of hours the horse has worked. In this section of the bulletin, a figure of 8 cents per hour has been used.

The cost of horse labour varies considerably on different farms, depending upon how the horses are kept and the amount of work they do. The cost in-

cludes interest, depreciation, harness, shoeing, veterinary charges, stabling, feed and labour. This amounts to about $64 per year under average farm conditions, it has been estimated; while the number of hours worked per horse per year is estimated at approximately 800 hours. Where horses are worked more than this amount, the cost becomes somewhat greater although the cost per hour for the hours worked may be reduced. In a survey of ten private farms made in 1929, the average annual cost was actually $71.34, while the average number of hours worked per horse, per year was only 590, making a cost of 12 cents per hour.

While the cost of 8 cents per hour for horse labour has been used in most of the calculations in this bulletin as covering the period of years from 1923 to 1930 some calculations have been made for 1931 conditions when the prices of farm products were very low. For 1931, the cost of horse labour has been figured at 5 cents per hour. It is based on a valuation of $50 per horse and $20 for harness. Estimating interest and depreciation on these costs and on a valuation of $100 per horse for stabling accommodation and reckoning the gross revenue at 1931 prices from three to four acres of land necessary to produce the feed required for one horse, it will be seen that this will readily amount to $40 per year. With horses working 800 hours annually, the cost would be 5 cents per hour. It will be seen that if the cost of production rather than the gross revenue at 1931 prices had been used for the land necessary to grow the feed, the cost per hour would have been greater. Besides no charge has been made for the labour of looking after the horses.

TRACTOR LABOUR

The method of determining the charge for tractor labour is discussed on page 52 of this bulletin. In the various detailed statements in this section of the bulletin, the costs of producing the various crops have been based on the field work being done with horse labour and not with tractors. For convenience in this bulletin, one tractor has been considered as doing the work of twelve horses.

MACHINERY

The charge per acre for farm machinery varies widely, depending upon the amount of machinery owned, the care which is given to it, and the number of acres under cultivation. The total annual charge for machinery consists of depreciation, interest, repairs and housing. There are several systems by which the operating cost of machinery may be charged against farm crops. The system used in this bulletin consists in finding the total annual charge for all machinery, not including tractors, threshing machinery or trucks, and dividing this charge by the number of acres under cultivation. Where it is desired to know the machinery cost for different crops, such as grain, hay or corn, a modification of the above system may be used. This consists in finding the total annual operating cost of all general machinery used in preparing the soil for all crops and apportioning this amount according to the hours used on each crop. The operating cost of special machines used for one crop only is then charged against this crop by dividing the total operating cost by the number of acres of that crop.

Depreciation consists in charging off enough of the initial cost price of any implement to replace the capital invested in it at the end of its period of usefulness. It may happen that the amount charged is not sufficient or it may be too great. However, as there is no means of predicting the cost of implements at some future date, the charge for depreciation is usually based on the initial cost and on the life of the machine. Thus, if the life of any given machine is 10 years, an amount equal to 10 per cent of the cost price is charged off each year as a depreciation or replacement charge.

The interest charge on farm machinery may be calculated by charging the current rate of interest, as obtained on first mortgages, against its inventory value. The result gives an interest charge on the present valuation or on the money that might be realized from the immediate sale of the implements. Another method of computing interest takes into account the average investment over the life of the machines. The average investment in a machine is the sum of all inventory values during the life of the machine divided by the number of years in the life period. The annual interest charge for machinery is derived by multiplying this value by the current rate of interest. As the amount arrived at by the use of the "average investment" method is but slightly more than one-half the cost price of the machine, the practice of charging the current rate of interest on one-half the cost price is frequently adopted. This method has the advantage of eliminating error in evaluation, is a constant figure for any one machine, is readily found, and is easy to apply. It has been used in this bulletin in calculating the interest charge on machinery. It is obvious that interest should not be charged on the full cost price of the machine, since an annual charge is written off for depreciation.

The charge for repairs is made up from the annual records of expenditure for these items, including cost of parts and repair labour. The total charge for housing is estimated by taking the depreciation, interest, and upkeep charges on the buildings used for storing the machines. The result is prorated among the machines in proportion to the space required by each machine.

An extensive study of the cost of operating general farm machinery in the Prairie Provinces has been made by the Central Experimental Farm, Ottawa, in which the information was received, by means of a questionnaire, from representative farmers in this area. The results of this survey may be found on page 45 of this bulletin. It was found that the average annual cost of operating general farm machinery was $1.35 per acre of cultivated land. This figure does not include the charge for machinery such as tractors, trucks and threshing machines. It must not be assumed that this machinery charge of $1.35 per acre represents an ideal arrangement. As will be seen by reference to page 25 of this bulletin on "The Cost of Producing Wheat on Certain Private Farms," a group of farmers who averaged 561 acres under cultivation had a machinery charge of only 55 cents per acre, and several had considerably less than this. However, in order to cover general conditions throughout the country the charge of $1.35 per acre has been used in this bulletin.

THRESHING AND ENSILING

Where outfits are rented, the rental charge, as well as the cost of the labour and board of the men should be included. Where the outfits are owned a proper proportion of the annual cost should be charged. In this section of the bulletin the cost of threshing, including machinery and labour has been charged at 12 cents per bushel for wheat and rye, 8 cents for oats and 10 cents for barley. The cost of hauling must be calculated for each particular farm as it varies, depending upon the distance from the elevator. The charge for ensiling, including labour and ensiling machinery has averaged $1 per ton where the yield was 5·87 tons per acre.

SEED, TWINE AND INSURANCE

Seed should be charged at actual cost or market valuation for clean seed. In the case of cultivated hay or pasture crops the cost of seed should be distributed equally over the crops to be secured from this seeding. In this bulletin seed grain has been valued at 20 per cent above the market price of the grain, while grass seed has been charged at actual cost. Twine was charged at 15

cents per pound in proportion to the amount used. Hail insurance has not been charged in this bulletin for the reason that such a charge tends to be repaid by payments for hail losses. Only the revenue for the actual yields harvested have been taken.

The rod weeder provides a rapid and economical means of controlling many kinds of weeds on summerfallow land.

SHARE OF SUMMER-FALLOW

When more than one crop is grown after summer-fallow, the cost of the summer-fallow should be proportioned to each succeeding crop according to the benefit derived. In most cases the first crop after a summer-fallow exhausts all the reserve soil moisture, but the cleaning influence of the summer-fallow is felt to some extent by the second crop and in some extreme instances may be carried over a longer period. In such cases where reclamation from weeds has been the main value of the summer-fallow, all costs exceeding those of a normal summer-fallow should be included as a capital charge on the land, while the balance is apportioned between the two succeeding crops. In this bulletin the cost of the summer-fallow has been divided on the basis of two-thirds being charged against the first crop and one-third against the second crop after the summer-fallow.

Return Values for Crops

GRAIN CROPS

The prices which should be credited for grain should be a fair market price for the grain sold in the district. The prices used in this bulletin represent the average price received for all grades of grain. It is almost impossible to set an accurate figure for the value of straw. Wheat straw, it is believed, should not be given any value, inasmuch, as a considerable proportion is burned. In this bulletin oat and barley straw have been given a value of $2 per ton. This is purely an arbitrary figure taken in the absence of any market price or any

knowledge of what proportion of these kinds of straw is used. On the basis of feeding value compared with hay, it should have a higher value than $2 per ton but as quite a proportion of this straw is not used the value of the total production would be somewhat less. In drought years oat and barley straw should be given a higher value.

HAY AND GREEN FEED

The value of hay and green feed should be the prevailing farm price for the district. The price used for hay in this bulletin represents the average farm prices given by crop correspondents throughout the Prairie Provinces and compiled by the Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa.

SILAGE CROPS

These crops are difficult to value. They are fed to live stock and not sold on the market to any extent. It is necessary, therefore, to estimate their value in comparison with some other crop used for a similar purpose. Since silage is usually substituted in the ration for a certain amount of hay, it is usual to compare silage with hay on the basis of their dry matter contents and their respective feeding values.

Corn silage has been valued in this bulletin on the basis of 300 pounds of silage in the silo being equal to 100 pounds of hay in storage, assuming that the silage contains 25 per cent dry matter. When silage contains less dry matter it should be given a lower valuation. Thus, if corn silage contained only 20 per cent dry matter it would take 375 pounds of silage to equal 100 pounds of hay. As average figures 350 pounds of sunflower silage are regarded as equal to 100 pounds of hay.

TABLE 2.—Summary of Cost of Production Factors used in Calculating the Cost of Production for the Dominion Experimental Farms

Item	Statement	Amount
		$
Items of Expense—		
Use of land and buildings	Rent or interest, taxes and upkeep per acre	3 35
Machinery	Total annual charge per acre	1 35
Seed	Seed grain at 20 per cent above market price, grass seed at actual cost—	
Twine	Per pound	0 15
Manual labour	Per hour	0 25
Horse labour	Per hour	0 08
Return Values—		
Wheat	Per bushel	0 93
Oats	"	0 37
Barley	"	0 46
Rye	"	0 68
Potatoes	"	0 72
Oat and barley straw	Per ton	2 00
Hay	"	10 92
Corn silage	"	3 64
Sunflower silage	"	2 53

COST OF PRODUCING CROPS ON THE DOMINION EXPERIMENTAL FARMS

Information on the cost of producing various farm crops on eight Dominion Experimental Farms in the Prairie Provinces is presented in this chapter for the period of years from 1923 to 1930 inclusive. Considerable data are given in regard to the cost of producing wheat on account of the importance of this crop, but figures are also given for oats, barley, fall rye, grass and legume hay, cereal hay, corn and sunflowers for silage, turnips and potatoes. The cost figures may be considered as fairly representative of conditions in different parts of the Prairie

Provinces, although the yields obtained on the Experimental Farms are higher than the average yields throughout the country. Uniform rates of manual and horse labour have been charged on all the Farms as well as uniform taxes, machinery charges, and twine and seed prices, but the hours of labour required to produce the crops have varied from Farm to Farm as has also the amount of twine and seed and the charge for the use of the land. This method has been followed in order to make the results as comparable as possible. The cost of hauling the grain from the farm to the elevator has not been included in the statements showing the cost of production on the Dominion Experimental Farms as this would vary widely depending upon the distance from the elevator.

Cost of Producing Wheat

In the present study, the cost of producing wheat has been determined on rotations where two successive crops of wheat are grown after summer-fallow. Itemized statements are presented below showing the average cost of summer-fallow, of producing wheat on fallow, and of wheat after wheat, from 1923 to 1930, on eight Dominion Experimental Farms in the Prairie Provinces of Canada. Two-thirds of the cost of summer-fallow has been charged to the first crop after fallow, and one-third to the second crop, on the assumption that the benefit derived by the two consecutive crops will be in that proportion. As the cost of summer-fallow does not vary greatly from year to year, the share of the cost charged against each of the two crops grown after fallow has been determined in the year the crops were grown, rather than in the two preceding years.

COST OF SUMMER-FALLOW

The average cost of summer-fallow on eight Dominion Experimental Farms in the Prairie Provinces, for the years 1923 to 1930, inclusive, is presented in the following table. The figures given are for summer-fallow after grain, on unmanured land.

TABLE 3.—Average Cost of Summer-fallow—Dominion Experimental Farms (1923-1930)

Item	Morden	Brandon	Indian Head	Rosthern	Scott	Swift Current	Lethbridge	Lacombe	Average for all farms
	$	$	$	$	$	$	$	$	$
Use of land	4 00	4 00	3 77	3 00	2 80	2 70	2 50	4 00	3 35
Machinery	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35
Manual labour at 25 cents per hour	1 77	2 18	2 30	1 36	1 34	0 79	1 42	1 75	1 61
Horse labour at 8 cents per hour	3 27	3 09	2 24	1 73	2 06	1 51	1 86	2 25	2 25
Total cost per acre	10 39	10 62	9 66	7 44	7 35	6 36	7 24	9 34	8 56

The average cost of summer-fallow on all Experimental Farms has been $8.56 per acre, and has ranged from $6.36 per acre at Swift Current to $10.62 per acre at Brandon. The highest cost in any year was $12.60 per acre at Brandon in 1928 while the lowest cost was $5.30 per acre at Swift Current in 1927. These differences in cost are due to different charges for the use of land, and to differences in labour requirements. The amount of labour required to handle summer-fallow depends on the size of teams used and the cultural practices followed. On the same farm there is very little difference in the cost of the summer-fallow from one year to another. If there is a heavy infestation of certain weeds, considerably more labour will be necessary than if the land is relatively clean.

COST OF PRODUCING WHEAT AFTER FALLOW

The average cost per acre of producing wheat after fallow, on eight Experimental Farms in the Prairie Provinces, is presented in the following table:—

TABLE 4.—Average Cost of Wheat after Fallow—Dominion Experimental Farms (1923–1930)

Item	Morden	Brandon	Indian Head	Rosthern	Scott	Swift Current	Lethbridge	Lacombe	Average for all farms
	$	$	$	$	$	$	$	$	$
Use of land	4 00	4 00	3 77	3 00	2 80	2 70	2 50	4 00	3 35
Seed at $1.18 per bushel	1 77	1 47	1 85	1 47	1 77	1 47	1 43	1 77	1 59
Machinery	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35
Twine at 15 cents per pound	0 35	0 45	0 41	0 51	0 30	0 32	0 47	0 46	0 40
Manual labour at 25 cents per hour	1 19	1 07	1 22	0 74	0 85	0 54	0 87	1 00	0 93
Horse labour at 8 cents per hour	1 16	0 93	0 84	0 59	0 75	0 54	0 65	0 79	0 78
Two-thirds cost of fallow	6 92	7 08	6 44	4 95	5 07	3 87	4 73	6 22	5 66
Threshing at 12 cents per bushel	3 77	3 95	3 16	3 19	2 43	2 57	3 70	3 55	3 29
Total cost per acre	20 51	20 30	19 04	15 80	15 32	13 36	15 70	19 14	17 40
Yield—bushels	31·4	32·9	26·4	26·6	20·2	21·4	30·8	29·6	27·4
Cost per bushel	0 65	0 62	0 72	0 59	0 76	0 62	0 51	0 65	0 64

The average cost of producing wheat after fallow on eight Experimental Farms has been $17.40 per acre. With an average yield of 27·4 bushels per acre this amounts to a cost of 64 cents per bushel. In addition to this there would be the cost of hauling the wheat from the farm to the elevator. The cost has varied considerably on the different Experimental Farms, ranging from $13.36 per acre at Swift Current to $20.51 at Brandon. This difference is due largely to higher priced land, more labour, heavier summer-fallow charges and greater threshing costs on account of larger yields at Brandon. The cost per bushel, however, on account of these larger yields, is exactly the same at 62 cents. The average cost per bushel on the eight Farms has ranged from 51 cents at Lethbridge to 76 cents at Scott. The highest yield and lowest cost per bushel on any of the farms during the period from 1923 to 1930 occurred at Lethbridge in 1928, when 52·1 bushels per acre were produced at a total cost of $18.32 per acre, or 35 cents per bushel. The lowest yield and highest cost per bushel occurred at Scott in 1924, when a yield of only 7·0 bushels per acre was secured at a total cost of $14.08, or $2.01 cents per bushel.

In these costs, machinery has been figured at $1.35 per acre. This charge is applicable to general farm conditions and espceially to smaller sized farms. The data on which it is based are presented on page 46 of this bulletin. However, on larger sized farms this cost for machinery would be reduced considerably. On a number of private farms where the acreage under cultivation averaged 561 acres the machinery cost was only 55 cents per acre.

While the cost of the manual and horse labour are given as total amounts, detailed figures will be found on page 55 of this bulletin on the cost of performing various cultural operations, while on page 59 will be found figures on the cost of harvesting.

During the eight years ending with 1930, the average return value of wheat in the Prairie Provinces has been 93 cents per bushel. The average profit for wheat grown after fallow on eight Experimental Farms has been $8.08 per acre, or 29 cents per bushel.

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COST OF PRODUCING WHEAT AFTER WHEAT

In this study, the cost of producing wheat after wheat has been determined on eight Dominion Experimental Farms in the Prairie Provinces. The following statement presents the average cost for the years 1923 to 1930, inclusive:—

TABLE 5.—Average Cost of Producing Wheat after Wheat—Dominion Experimental Farms (1923-1930)

Item	Morden	Brandon	Indian Head	Rosthern	Scott	Swift Current	Lethbridge	Lacombe	Average for all farms
	$	$	$	$	$	$	$	$	$
Use of land	4 00	4 00	3 77	3 00	2 80	2 70	2 50	4 00	3 35
Seed at $1.18 per bushel	1 77	1 47	1 51	1 47	1 77	1 47	1 43	1 77	1 58
Machinery	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35
Twine at 15 cents per pound	0 32	0 43	0 28	0 39	0 29	0 26	0 31	0 30	0 32
Manual labour at 25 cents per pound	1 90	1 81	2 08	1 13	1 48	1 03	1 63	1 05	1 51
Horse labour at 8 cents per hour	2 13	2 10	1 77	1 18	1 71	1 49	1 64	1 00	1 63
One-third cost of summer-fallow	3 46	3 54	3 22	2 48	2 51	1 94	2 50	3 11	2 84
Threshing at 12 cents per bushel	3 17	2 47	2 05	2 70	2 09	1 52	2 51	2 46	2 37
Total cost per acre	18 10	17 17	16 03	13 70	14 00	11 76	13 87	15 06	14 95
Yield in bushels	26·4	20·6	17·1	22·5	17·4	12·7	20·9	20·5	19·8
Cost per bushel	0 69	0 83	0 94	0 61	0 80	0 93	0 66	0 74	0 75

The average cost of producing wheat after wheat, on eight Experimental Farms, has been $14.95 per acre with an average yield of 19·8 bushels per acre. The average cost of production has been 75 cents per bushel. As in the case of wheat after fallow, the average cost has varied on different Experimental Farms, ranging from $11.76 per acre for an average yield of 12·7 bushels at Swift Current to $18.10 per acre for an average yield of 26·4 bushels at Morden. The highest total cost per acre in any one of the eight years occurred at Morden in 1929, when 23·5 bushels per acre were grown at a total cost of $20.36. The lowest total cost occurred at Rosthern in 1924, when 3·0 bushels per acre were grown at a total cost of $10.63.

The cost per bushel of wheat after wheat has varied more widely than wheat after fallow. Excluding one case of complete failure at Indian Head in 1929, the cost per bushel in different years has ranged from 44 cents at Rosthern in 1925 to $6.70 at Scott in 1924. At a return value of 93 cents per bushel the average profit on wheat after wheat for the eight Experimental Farms has been $3.46 per acre, or 17 cents per bushel.

In the foregoing discussion of the cost of producing wheat, the cost of summer-fallow has been arbitrarily charged against the first and second crops after fallow, in the proportion of two-thirds and one-third respectively. The difficulty of arriving at a just apportionment of the summer-fallow cost may be overcome by adding together the costs of summer-fallow, and the cost of producing the following two wheat crops. The sum so obtained, divided by the total yield of both crops of wheat, will give the average cost per bushel for the rotation, without any arbitrary division of summer-fallow costs. In the following table, the average cost of wheat after fallow, and wheat after wheat, on eight Dominion Experimental Farms in the Prairie Provinces are summarized for the years 1923 to 1930, inclusive.

TABLE 6.—Average Cost of Producing Wheat on a Summer-fallow, Wheat, Wheat, Rotation—Dominion Experimental Farms (1923–1930)

Item	Morden	Brandon	Indian Head	Rosthern	Scott	Swift Current	Lethbridge	Lacombe	Average for all farms
	$	$	$	$	$	$	$	$	$
Total cost of wheat after fallow	20 51	20 30	19 04	15 80	15 32	13 36	15 70	19 14	17 40
Total cost of wheat after wheat	18 10	17 17	16 03	13 70	14 00	11 76	13 87	15 06	14 95
Average cost per cropped acre	19 30	18 73	17 53	14 75	14 66	12 56	14 78	17 10	16 17
	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.	bush.
Yield per acre of wheat after fallow	31·4	32·9	26·4	26·6	20·2	21·4	30·8	29·6	27·4
Yield per acre of wheat after wheat	26·4	20·6	17·1	22·5	17·4	12·7	20·9	20·5	19·8
Average yield	28·9	26·7	21·7	24·5	18·8	17·0	25·8	25·0	23·6
	$	$	$	$	$	$	$	$	$
Average cost per bushel	0 67	0 70	0 81	0 60	0 78	0 74	0 57	0 68	0 69

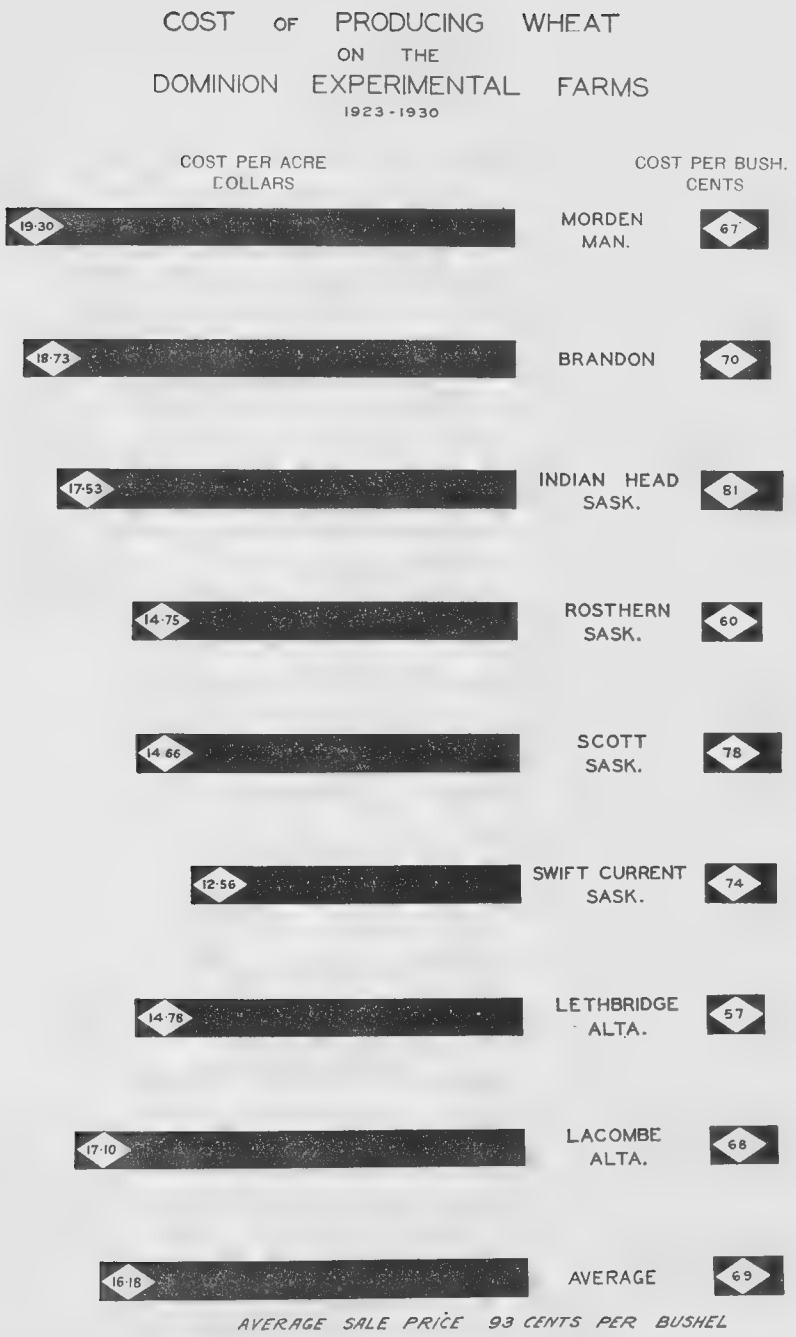
The average total cost of producing two successive crops of wheat after fallow on the eight Experimental Farms has been 69 cents a bushel. With the return value for wheat at 93 cents per bushel, the average profit would be 24 cents a bushel or, with an average yield of 23·6 bushels, a profit of $5.78 per cropped acre or, considering the land in summer-fallow $3.85 per cultivated acre.

The results obtained on the various Experimental Farms during the eight years ending with 1930, as given above, are not absolutely indicative of results over a longer period of years. Thus at Indian Head for the period from 1923 to 1930 the average yields have been lower than for a longer period while at Lethbridge, on the other hand, they have been higher.

No reference has been made in the foregoing discussion to the cost of producing wheat in a two-year rotation of summer-fallow and wheat, nor to the cost of producing wheat in a rotation without summer-fallow. The advisability of growing one as against two crops of wheat after summer-fallow is discussed on page 44 of this bulletin. Where no summer-fallow year is included in a rotation, the cost of producing wheat is approximately the same as for wheat after wheat, less the charge for summer-fallow. Where wheat follows an inter-tilled crop, however, the cost of production per acre may be expected to approximate that of wheat after summer-fallow, less the charge for summer-fallow.

THE EFFECT OF VARYING YIELDS PER ACRE ON THE COST OF PRODUCING WHEAT

The cost per bushel of producing wheat varies inversely as the yield secured, owing to the fact that certain costs remain the same irrespective of the yield. The total cost of producing wheat is composed of various fixed charges for land, machinery, and seed, and of variable charges for labour, twine, and threshing, as indicated in the preceding sections of this study. Normally, the cost of threshing may be expected to vary directly as the yield of grain, although where the yield is very low, a minimum fixed charge for threshing per hour may be made. The amount of twine used will depend on the yield of straw, which will not necessarily vary at the same rate as the yield of grain. Where combines are used for harvesting, of course, twine does not appear in the cost of production, and the cost of harvesting may be different than where binders and ordinary threshing outfits are employed. In this study the cost of producing wheat has been calculated only for crops harvested with the binder.



In the following table the average relationship between the yield and cost per acre and per bushel of wheat as determined on eight Experimental Farms in the Prairie Provinces is presented for the years 1923 to 1930 inclusive. The average costs have been determined for wheat after fallow. Owing to the different conditions existing on the various Experimental Farms, the cost

of production per acre, as presented in the following table, does not show a uniform increase in every case equal to the difference in the threshing cost. It does show, however, a very striking decrease in the cost of production per bushel with higher yields.

TABLE 7.—Relation of Yield to Cost of Producing Wheat—Average of Eight Dominion Experimental Farms in the Prairie Provinces, 1923–1930

Yield bushels per acre	Wheat after fallow	
	Cost per acre	Cost per bushel
	$	$
5	14 30	2 86
10	14 85	1 48
15	15 70	1 05
20	16 55	0 83
25	17 35	0 69
30	18 20	0 61
35	18 70	0 53
40	19 15	0 48
45	19 55	0 43
50	20 00	0 40

Cost of Producing Oats

Studies of the cost of producing oats have been made on six of the Dominion Experimental Farms in the Prairie Provinces. The average cost of producing oats after grain, for the years 1923 to 1930, inclusive, on unmanured land, is presented below.

TABLE 8.—Average Cost per Acre of Producing Oats—Dominion Experimental Farms in the Prairie Provinces, 1923–1930

Item	Morden	Brandon	Indian Head	Rosthern	Scott	Lacombe	Average for all farms
	$	$	$	$	$	$	$
Use of land	4 00	4 00	3 74	3 00	2 80	4 00	3 59
Seed at 47 cents per bushel	0 92	0 94	0 63	0 94	0 64	1 06	0 86
Machinery	1 35	1 35	1 35	1 35	1 35	1 35	1 35
Twine at 15 cents per pound	0 34	0 43	0 31	0 40	0 34	0 43	0 37
Manual labour at 25 cents per hour	1 52	1 62	2 45	1 30	1 32	1 47	1 61
Horse labour at 8 cents per hour	1 72	2 46	1 99	1 34	1 53	1 60	1 77
Threshing at 8 cents per bushel	5 14	3 06	3 79	4 35	3 51	3 91	3 97
Total cost per acre	14 99	13 86	14 26	12 68	11 49	13 82	13 52
Yield per acre, bushels	64·3	38·3	47·4	54·4	43·9	48·9	49·6
Cost per bushel	0 23	0 36	0 30	0 23	0 26	0 28	0 27

The average cost of producing oats on stubble, as will be seen from the above table, has been $13.52 per acre, or 27 cents per bushel. The average cost per acre has not varied very greatly on the different Farms, ranging from $14.99 at Morden to $11.49 at Scott. The variation in the cost per bushel, however, has been more marked, the cost ranging from 23 cents a bushel at Morden and Rosthern to 36 cents at Brandon.

The average return value of oats, for the years 1923 to 1930 inclusive, has been 37 cents per bushel. At this price the average gross revenue would be $18.35 per acre or an average profit of $4.83 per acre. If the yield of straw is assumed to average 150 per cent of the yield of grain by weight, and the straw valued at $2 per ton, the profit per acre is increased by $2.93.

Cost of Producing Barley

The average cost of producing barley on six Dominion Experimental Farms in the Prairie Provinces is presented in the statement given below. On all of the Farms, with the exception of Morden, barley is grown on manured land. In these cases a charge for manure is made, at the rate of $1 per ton, the total charge per acre being made equally against all crops in the rotation.

TABLE 9.—Average Cost per Acre of Producing Barley—Dominion Experimental Farms in the Prairie Provinces, 1923–1930

Item.	Morden	Brandon	Indian Head	Rosthern	Scott	Lacombe	Average for all forms
Use of land.....$	4 00	4 00	3 74	3 00	2 80	4 00	3 59
Manure.....$	0 00	1 00	1 87	2 43	1 87	2 00	1 69
Seed at 59 cents per bushel..$	1 03	1 11	1 23	1 18	1 18	1 08	1 13
Machinery.....$	1 35	1 35	1 35	1 35	1 35	1 35	1 35
Twine at 15 cents per pound.$	0 33	0 46	0 48	0 37	0 39	0 36	0 40
Manual labour at 25 cents per hour.....$	1 90	1 55	2 05	1 20	0 97	1 45	1 52
Horse labour at 8 cents per hour.....$	2 18	2 18	1 22	1 19	0 87	1 62	1 54
Threshing at 10 cents per bushel.....$	4 14	4 81	3 40	3 45	3 77	2 71	3 71
Total cost per acre.....$	14 93	17 46	15 34	14 17	13 20	14 57	14 93
Yield.....bushels	41·4	48·1	34·0	34·5	37·7	27·1	37·1
Cost per bushel.....$	0 36	0 36	0 45	0 41	0 35	0 54	0 40

The average cost of producing barley, according to the above table, has been $14.93 per acre or, considering the yield of 37·1 bushels per acre at 40 cents per bushel. The cost per acre has ranged from $13.20 at Scott to $17.46 at Brandon. The cost per bushel has ranged from 35 cents at Scott to 54 cents at Lacombe. The foregoing variations are due in part to varying labour requirements for barley grown on stubble and barley after hoed crops.

At the return value for barley of 46 cents per bushel, the average gross revenue would be $25.60 per acre and the profit $2.14, or 6 cents per bushel. If the value of straw at $2 per ton is added to that of barley, on the assumption that the straw yield equals 150 per cent of the grain yield, the return value per acre is increased by $2.67.

Cost of Producing Fall Rye

Cost of production data for fall rye are available on five of the Dominion Experimental Farms in the Prairie Provinces. The average cost of production is presented in the following statement:—

TABLE 10.—Average Cost per Acre of Producing Fall Rye—Dominion Experimental Farms in the Prairie Provinces, 1923–1930

Item	Morden	Scott	Swift Current	Leth-bridge	Lacombe	Average for all farms
Use of land..... $	4 00	2 80	2 70	2 50	4 00	3 20
Manure..... $	.....	.....	.....	1 33	3 75	1 01
Seed at 88 cents per bushel..... $	1 10	1 15	0 88	1 03	0 88	1 01
Machinery..... $	1 35	1 35	1 35	1 35	1 35	1 35
Twine at 15 cents per pound..... $	0 31	0 30	0 36	0 49	0 39	0 37
Manual labour at 25 cents per hour. $	1 02	0 90	0 47	1 00	1 25	0 93
Horse labour at 8 cents per hour... $	0 77	0 69	0 43	0 72	1 22	0 77
Share of summer-fallow cost..... $	3 26	2 62	4 37	3 05	.....	2 66
Threshing at 12 cents per bushel.. $	3 86	1 90	2 24	3 98	2 47	2 89
Total cost per acre..... $	15 67	11 71	12 81	15 45	15 31	14 19
Yield per acre.....bush.	32·2	15·8	18·7	33•2	20·6	24·1
Cost per bushel..... $	0 49	0 74	0 68	0 46	0 74	0 59

The average cost per acre of producing fall rye on these five Experimental Farms has been $14.19, or 59 cents per bushel. As the average return value of fall rye for the years 1923 to 1930, inclusive, has been 68 cents per bushel, the average profit per acre has been $2.17 or 9 cents per bushel. For ordinary purposes, rye straw may be considered as having no value. It will be observed that the cost of production of rye at Scott and Lacombe exceeds its return value, while at Morden and Lethbridge some profit has been made.

Cost of Producing Hay

The cost of producing hay in the Prairie Provinces varies widely in different localities, depending chiefly on the yields secured. The average cost of producing hay, under the different conditions obtaining on eight Dominion Experimental Farms in the Prairie Provinces is presented in the following statement:—

TABLE 11.—Average Cost Per Acre of Producing Hay—Dominion Experimental Farms, 1923-1930

Item	Morden	Brandon	Indian Head	Rosthern	Scott	Swift Current	Lethbridge	Lacombe	Average for all farms
Use of land..... $	4 00	4 00	3 74	3 00	2 80	2 70	2 50	4 00	3 35
Seed..... $	1 69	1 86	1 77	1 03	1 62	0 37	1 90	1 72	1 49
Machinery..... $	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35
Manual labour at 25 cents per hour..... $	3 20	1 95	2 95	1 30	1 50	0 95	2 18	1 90	1 99
Horse labour at 8 cents per hour..... $	0 95	1 04	1 22	0 47	0 68	0 56	0 96	0 62	0 81
Total cost per acre..... $	11 19	10 20	11 03	7 15	7 95	5 93	8 89	9 59	8 99
Yield per acre.....tons	2·19	2·28	1·31	1·20	1·08	0·76	1·29	1·45	1·44
Cost per ton..... $	5 11	4 47	8 42	5 96	7 36	7 80	6 89	6 61	6 23

The average cost of producing hay on the Dominion Experimental Farms in the Prairie Provinces has been $8.99 per acre, or $6.23 per ton for a yield of 1·44 tons per acre. Considerable variation in cost has occurred on different Experimental Farms, the cost per acre having ranged from $5.93 at Swift Current to $11.19 at Morden, while the cost per ton has varied from $4.47 at Brandon to $8.42 at Indian Head.

For the period for which the foregoing average figures have been determined, the average return value of grass and clover hay has been $9.46 per ton, while that of alfalfa hay has been $12.38 per ton. The average of these values, $10.92, may be taken as the average return value for the preceding table. On this basis, the average profit has been $6.75 per acre. It would be unsafe, however, to apply the value of $10.92 per ton for hay owing to the limited market for it, and the uncertainty of obtaining this value when fed to stock.

The difficulty of securing a satisfactory yield of hay is an important problem in the Prairie Provinces, owing to the limited rainfall in this region, and to the fact that while it usually falls at a very favourable season for grain it is somewhat too late for hay, causing the yields to be considerably lower than those secured in the humid regions of Eastern Canada. Thus on the Central Experimental Farm at Ottawa the average yield of hay over a period of twenty years has been 3·56 tons per acre while the best yield in the above table was 2·28 tons at Brandon and the lowest yield 0·76 of a ton at Swift Current. On the other hand, the prairie farms have the advantage of a more favourable climate and soil for grain.

However, in those districts on the prairie where there is a fair amount of precipitation, the growing of some hay, especially legume hay, is very advisable. In such districts the hay takes the place of a certain acreage of summer-fallow and entails much less expense than summer-fallow. Besides, the yields after legume hay crops are usually very good. These results, however, are not

secured in the drier regions of the prairie where poor crops of hay are produced and yields following hay are no better than those following grain. For further information in regard to mixed farming rotations the reader is referred to Bulletin 98, New Series, "Crop Rotations and Soil Management for the Prairie Provinces," which may be secured free by writing to the Publications Branch, Department of Agriculture, Ottawa.

In districts where sufficient precipitation is received legume hay crops provide good yields and leave the soil in an excellent condition for subsequent crops.

In dry seasons on the prairie, failure to obtain a catch of grass or legume hay or to produce a crop from a previous seeding are fairly frequent, especially in the drier districts. Where failures occur it is necessary to grow some form of cereal hay.

The cost of seed is one of the more variable items in the cost of producing hay on the different Experimental Farms, the cost depending both on the price of the seed and the number of years the hay is left down. According to the preceding table, the charge for hay seed has varied from $1.90 per acre at Lethbridge to 37 cents at Swift Current. At Lethbridge a considerable amount of alfalfa seed at 44 cents per pound has been sown while at Swift Current the grass seed has cost only 12.5 cents per pound. In general, the average charge of $1.49 per acre for hay seed may be considered as a fair approximation.

In the preceding table of average costs, no charge has been made for manure, although in many cases of the rotations included in the averages manure was applied to the land on which the hay was grown. The charge for manure was omitted because of the observed slight response of hay to manurial treatment.

Cost of Producing Cereal Hay

Data on the cost of producing cereal hay are presented for two of the Dominion Experimental Farms in the Prairie Provinces. Oats are grown for annual hay at Brandon, while a mixture of peas and oats, in the ratio of five of peas to one of oats, by weight, is sown at Lethbridge. The following table gives the cost per acre of producing annual hay at the above mentioned Farms:—

TABLE 12.—Average Cost per Acre of Producing Annual Hay—Dominion Experimental Farms in the Prairie Provinces, 1923–1930

Item		Oat hay	Pea and oat hay
		Brandon	Lethbridge
Use of land	$	4 00	2 50
Manure	$	1 00	1 66
Seed—Oats at 47 cents per bushel	$	0 94	0 31
Peas at $3 per bushel	$	.....	5 82
Machinery	$	1 35	1 35
Manual labour at 25 cents per hour	$	1 80	2 25
Horse labour at 8 cents per hour	$	0 95	1 47
Two-thirds of cost of summer-fallow	$	.....	5 74
Cost per acre	$	10 06	21 12
Yield	tons	2·13	2·60
Cost per ton	$	4 72	8 12

The average cost per acre of producing oat hay at Brandon has been $10.06 for a yield of 2·13 tons, or $4.72 per ton. Referring to table 11, it will be seen that the average cost of producing ordinary hay at Brandon is $10.20 per acre, for a yield of 2.28 tons. It is evident, therefore, that oat hay may be more cheaply produced, but this advantage may be partly off-set by the greater value of the ordinary hay, which, at Brandon, is composed largely of alfalfa.

The relatively high cost per acre of producing pea and oat hay at Lethbridge is due, in part, to the high cost of seed, and to the inclusion of summer-fallow charges. The total average cost per acre has been $21.12, of which $11.87 or 56.2 per cent are chargeable against seed and summer-fallow. Due to the relatively high average yield of 2.60 tons per acre, however, as compared with 1·29 ton per acre for ordinary hay, the cost per ton has been only $8.12 as compared with 8.89 for ordinary hay.

It must be remembered that the foregoing data on annual hay are for two Farms only, and are indicative, rather than representative, of conditions throughout the Prairie Provinces.

Cost of Producing Corn Silage

The principal crops grown for silage on the Dominion Experimental Farms in the Prairie Provinces are corn and sunflowers. Corn is grown on all the Farms excepting Scott, while sunflowers are grown at Morden, Rosthern, and Lacombe. The average costs of producing corn are presented in the following tables:—

TABLE 13.—Cost per Acre of Producing Corn for Silage—Dominion Experimental Farms in the Prairie Provinces, 1923–1930

Item		Morden	Brandon	Indian Head	Rosthern	Swift Current	Lethbridge	Lacombe	Average for seven farms
Use of land	$	4 00	4 00	3 74	3 00	2 70	2 50	4 00	3 42
Manure	$	1 67	1 30	1 17	1 68	.....	1 33	1 87	1 29
Seed at $3.90 per bushel	$	1 95	0 97	1 87	2 18	0 97	0 97	1 44	1 47
Machinery	$	1 35	1 35	1 35	1 35	1 35	1 35	1 35	1 35
Twine at 15 cents per pound	$	0 25	0 45	0 45	0 45	0 18	0 52	0 45	0 39
Manual labour at 25 cents per hour	$	7 00	5 50	11 25	8 57	2 47	7 65	7 00	7 06
Horse labour at 8 cents per hour	$	4 18	3 58	4 28	4 90	2 14	2 50	4 02	3 66
Ensiling	$	7 40	4 26	7 15	1 10*	2 17	8 13	1 85*	4 57
Total cost per acre	$	27 80	21 41	31 26	23 23	11 98	24 95	21 98	23 21
Yield per acre	tons	8·92	5·33	6·16	6·14	2·49	6·45	6·87	6·05
Cost per ton	$	3 12	4 02	5 07	3 78	4 81	3 87	3 20	3 84

*Extra machinery charges only.

A very important fact to be observed in the above table is the rather low average yield of 6.05 tons per acre of silage corn, the yields ranging from 2.49 tons per acre at Swift Current to 8.92 tons at Morden. The costs per acre, however, have also been low averaging $23.21 per acre.

On all the Farms except Rosthern and Lacombe, the cost of ensiling as shown in the above table represents the total cost of putting the corn in the silo. At Rosthern and Lacombe, however, the cost of ensiling is included in the labour charges, separate charges being made for the ensiling machinery. On the five farms where a total charge for ensiling is made, the average cost of ensiling is $5.82 per acre or approximately $1 per ton.

Assuming 300 pounds of corn silage to be equal in value to 100 pounds of hay and hay to be worth $10.92 per ton the average value per ton of corn silage for the years 1923 to 1930 inclusive, would be $3.64 per ton. At this value, with an average yield of 6.05 tons per acre the gross revenue would be $22.02 per acre produced at an average cost of $23.21 per acre. This makes a loss of $1.19 per acre. On only two of the Farms, Morden and Lacombe, has corn silage been produced at a profit. In these cases, the yield has been relatively high.

Cost of Producing Sunflower Silage

Figures on the cost of production of sunflower silage are available on three of the Dominion Experimental Farms in the Prairie Provinces.

TABLE 14.—Cost per Acre of Producing Sunflower Silage—Dominion Experimental Farms in the Prairie Provinces, 1923-1930

Item		Morden	Rosthern	Lacombe	Average for three farms
Use of land	$	4 00	3 00	4 00	3 66
Manure	$	3 00	2 75	2 00	2 58
Seed at 12 cents per pound	$	1 44	2 70	1 32	1 82
Machinery	$	1 35	1 35	1 35	1 35
Twine at 15 cents per pound	$	0 28	0 51	0 52	0 44
Manual labour at 25 cents per hour	$	6 42	9 72	9 93	8 69
Horse labour at 8 cents per hour	$	3 97	5 72	4 38	4 69
Ensiling	$	10 85	1 29*	2 00*	4 71
Total cost per acre	$	31 31	27 04	25 50	27 95
Yield per acre	tons	13·91	7·17	9·79	10·29
Cost per ton	$	2 25	3 77	2 60	2 72

*Extra machinery charge only.

The yield of sunflowers has been considerably higher than that of corn being 10.29 tons per acre, as compared with 6.05 tons for corn. The cost of production has averaged $27.95 per acre or $2.72 per ton.

The value of sunflower silage may be computed by considering 350 pounds of sunflower silage as equal to 100 pounds of hay. If the average value of hay is $10.92 per ton, the value of sunflower silage would be $3.12 per ton. With an average yield of 10.29 tons per acre the gross revenue would be $32.10 per acre produced at an average cost of $27.95 per acre. At Rosthern, sunflower silage has been produced at a loss while at Morden and Lacombe a small profit has been realized.

Green oats have been ensiled at Lacombe, at an average cost over four years of $22.65 per acre. With an average yield of 6.99 tons per acre the cost has been $3.24 per ton. Assuming 280 pounds of oat silage as equal in feeding value to 100 pounds of hay, the value of the silage would be $3.90 per ton.

Cost of Producing Turnips

Data on the cost of producing turnips on summer-fallow land on the Experimental Farm at Rosthern for the years 1923 to 1930 inclusive are presented in the following statement:—

TABLE 15.—Cost of Producing Turnips—Rosthern Experimental Farm, 1923–1930

Item	Amount
Use of land	$3 00
Manure	1 87
Seed at 90 cents per pound	2 61
Machinery	1 35
Manual labour at 25 cents per hour	17 35
Horse labour at 8 cents per hour	3 71
Two-thirds of cost of summer-fallow	4 82
Total cost per acre	34 71
Yield per acre—tons	15·29
Cost per ton	2 27

Of the total cost of $34.71 per acre of producing turnips at Rosthern, $21.06, or 60·7 per cent, is chargeable to labour. Assuming 600 pounds of turnips to be equal in feeding value to 100 pounds of hay, the value of the turnips would be $1.82 per ton. With a yield of 15·29 tons per acre the total value would be $27.83 per acre. However, as the cost of production was $34.71 the loss on the turnips would be $6.88 per acre.

Cost of Producing Potatoes

Records on the cost of producing potatoes have been kept for several years at the Dominion Experimental Farm at Lacombe. Results for the eight-year period, 1923 to 1930, are presented in the following statement:—

TABLE 16.—Average Cost per Acre of Producing Potatoes—Lacombe Experimental Farm, 1923–1930

Item	Amount
Use of land	$4 00
Manure	2 14
Seed potatoes at $1 per bushel	26 60
Machinery	1 35
Manual labour at 25 cents per hour	24 10
Horse labour at 8 cents per hour	7 28
Total cost per acre	65 47
Yield per acre—bushels	239·2
Cost per bushel	0 27

The average cost per acre of producing potatoes at Lacombe has been $65.47 or 27 cents per bushel. The charge for labour amounts to $31.38 or 47·9 per cent of the total cost, and includes the entire labour cost until the potatoes are placed in storage on the farm. The charge of $26.60 for seed potatoes represents the highest fixed charge against the crop, that of labour being variable, depending on the yield obtained. The relatively low cost per bushel of 27 cents is due to the high average yield of 239·2 bushels per acre. To the cost of 27 cents per bushel it may be necessary to add the cost of mar-

keting the potatoes. This would amount to approximately 6·6 per bushel for bags, 6 cents for grading and bagging, and 3 cents for hauling, or a total of 15·6 cents per bushel.

The average return value of potatoes in Western Canada, during the years 1923 to 1930 inclusive, is given by the Dominion Bureau of Statistics at 72 cents per bushel. It is very doubtful whether any appreciable market would be available at this price.

A combination that enables one man to seed fifty acres of summerfallow land per day.

COST OF PRODUCING WHEAT ON CERTAIN DOMINION ILLUSTRATION STATIONS IN MANITOBA, SASKATCHEWAN AND ALBERTA

The Dominion Experimental Farm system conducts certain experimental and demonstrational work on private farms throughout Canada. An area of land is rented from a representative farmer who agrees to undertake specified lines of work as directed. These places are known as Dominion Illustration Stations. Considerable information has been obtained on these stations in regard to the cost of producing various farm crops. Through the courtesy of J. C. Moynan, B.S.A., Chief Supervisor of these stations, the following data are available covering the cost of producing wheat, from 1922 to 1930, inclusive, in the Prairie Provinces. In Saskatchewan and Alberta these costs relate to wheat grown in a three-year rotation of summer-fallow, wheat, wheat, and in Manitoba to a five-year rotation of summer-fallow, wheat, hay, wheat, oats. Two-thirds of the summer-fallow cost is charged against the first wheat crop and one-third against the crop which follows.

TABLE 17.—Cost of Producing Wheat after Summer-fallow on the Dominion Illustration Stations in Manitoba, Saskatchewan and Alberta

Station	Number of years	Cost per acre summer-fallow	Yield per acre	Cost per acre	Cost per bushel
		$	bush.	$	$
Dugald, Man.	2	8 65	28·5	16 61	0 59
Gunton, Man.	6	7 29	24·3	16 06	0 66
Katrime, Man.	2	7 14	14·7	15 00	1 02
Petersfield, Man.	4	11 57	33·6	19 83	0 59
Plumas, Man.	4	8 35	18·3	12 51	0 70
Roblin, Man.	3	8 28	18·7	15 49	0 83
Ste. Rose, Man.	4	5 53	14·5	12 20	0 84
Kamsack, Sask.	5	8 06	22·9	12 37	0 54
Kindersley, Sask.	2	7 73	29·8	16 83	0 56
Lloydminster, Sask.	2	7 44	23·2	14 76	0 38
Marcelin, Sask.	2	7 39	21·0	15 29	0 73
Meadow Lake, Sask.	2	5 22	40·3	13 95	0 35
Meota, Sask.	8	7 23	34·3	17 53	0 51
Spruce Lake, Sask.	2	6 40	26·0	12 88	0 49
Avonlea, Sask.	7	7 41	15·0	14 32	0 95
Fox Valley, Sask.	3	6 86	22·8	14 08	0 62
Herbert, Sask.	8	7 73	15·8	15 39	0 97
Radville, Sask.	7	6 88	23·3	15 13	0 65
Riverhurst, Sask.	8	6 87	21·0	14 60	0 70
Shaunavon, Sask.	6	6 83	22·6	14 74	0 65
Trossachs, Sask.	6	6 91	18·1	14 00	0 77
Tugaske, Sask.	8	6 98	19·0	14 99	0 79
Weyburn, Sask.	6	7 37	25·5	14 40	0 57
Bindloss, Alta.	6	5 27	20·9	12 27	0 59
Cessford, Alta.	4	4 89	23·8	12 07	0 50
High River, Alta.	6	8 72	37·0	20 41	0 55
Jenner, Alta.	4	5 32	21·4	12 13	0 57
Orion, Alta.	6	4 89	21·9	11 16	0 51
Whitla, Alta.	6	5 43	20·9	12 75	0 61
Youngstown, Alta.	6	4 94	14·6	11 50	0 79
Wainwright, Alta.	6	6 49	26·7	15 14	0 56
Average of 31 stations.	.....	6 97	23·2	14 53	0 63

TABLE 18.—Cost of Producing Wheat after Wheat on the Dominion Illustration Stations in Saskatchewan and Alberta

Station	Period of years	Yield per acre	Cost per acre	Cost per bushel
		bush.	$	$
Kindersley, Sask.	2	11 5	11 94	1 04
Lloydminster, Sask.	2	21·8	12 74	0 58
Marcelin, Sask.	2	18·0	13 76	0 76
Meadow Lake, Sask.	2	31·8	12 61	0 40
Meota, Sask.	2	22·8	14 80	0 65
Avonlea, Sask.	7	9·3	13 01	1 40
Fox Valley, Sask.	3	11·5	11 58	1 00
Herbert, Sask.	8	8·3	12 16	1 47
Radville, Sask.	7	11·1	12 20	1 10
Riverhurst, Sask.	8	14·7	12 56	0 85
Shaunavon, Sask.	6	12·4	11 61	0 94
Trossachs, Sask.	6	9·9	11 59	1 17
Tugaske, Sask.	6	14·2	12 97	0 91
Weyburn, Sask.	6	21·5	14 86	0 69
Bindloss, Alta.	6	14·9	9 99	0 67
Cessford, Alta.	4	14·1	9 49	0 67
High River, Alta.	6	30·8	17 34	0 56
Jenner, Alta.	4	15·0	10 50	0 70
Orion, Alta.	6	14·3	9 62	0 67
Whitla, Alta.	6	13·4	12 30	0 92
Youngstown, Alta.	6	11·2	10 59	0 94
Wainwright, Alta.	6	23·7	14 43	0 61
Average 22 stations.	.....	16·2	12 39	0 76

The cost of producing wheat after summer-fallow on 31 Illustration Stations in the three Prairie Provinces has averaged $14.53 per acre or, considering the average yield of 23·2 bushels per acre, at a cost of 63 cents per bushel. Wheat grown as second crop after summer-fallow in Alberta and Saskatchewan has cost $12.39 per acre, or considering the average yield of 16·2 bushels per acre, at a cost of 76 cents per bushel. The cost of the summer-fallow, which is charged against the two wheat crops in the above figures, has been $6.97 per acre. Second crop wheat grown on eight stations in Manitoba has cost $14.25 per acre but, with a higher yield of 21·8 bushels per acre, at a smaller cost of 65 cents per bushel. In addition to these costs, there would be the cost of hauling the grain from the farm to the elevator.

These costs are somewhat less than those secured on the Dominion Experimental Farms presented on page 13 of this bulletin or on several private farms presented on page 29. The chief reason for the lower costs on the Illustration Stations lies in the lower valuation being placed on the land, most of the Stations being located in regions where values are lower. Thus, while the Illustration Station land has been valued at $24 per acre, the land of the Experimental Farms has been valued at $42.68 and that of the private farms at $44.66 per acre. Differences in seed and threshing costs account for the remaining slight variations.

COST OF PRODUCING WHEAT ON CERTAIN PRIVATE FARMS AND FARM ORGANIZATION FOR GRAIN PRODUCTION

With a view to studying various private farm enterprises in the hope of learning how to effect greater economies in the production of grain, a survey was made in 1929 of 28 selected grain growing farms in the three Prairie Provinces. Valuable information was secured in this investigation, in regard to the investment involved in land, buildings and equipment, as well as in connection with the manual, horse and tractor power required to operate these farms. This information makes possible calculations of the cost of producing wheat on these farms and indicates some reasons why costs are considerably lower on some farms than on others.

Size and Value of Farms

The farms which were examined varied in size from quarter section to two sections. The value of the land and the initial investment in equipment also varied widely as will be seen by reference to the following table. In this table the farms have been classified by quarter-section units, those having smaller or larger acreages being placed in their nearest size class.

TABLE 19.—Average Size and Value of Farms

Approximate size of farm	Number of records	Total farm acres	Cultivated acres	Total value of land and buildings		Value of horses and equipment	Total investment in land, buildings and equipment
				Per farm	Per acre		
				$	$	$	$
¼ section	2	170	140	11,400	67 06	1,508	12,908
½ section	6	328	284	17,000	51 83	3,814	20,814
¾ section	6	480	363	24,610	51 27	5,342	29,952
1 section	7	645	533	31,883	49 43	5,094	36,977
1¼ section	3	807	712	37,717	46 74	6,324	44,041
1½ section	1	940	780	47,000	50 00	7,724	54,724
1¾ section	2	1,120	1,098	67,200	61 20	9,341	76,541
2 sections	1	1,280	1,150	38,400	30 00	5,402	43,802

One outstanding fact brought out by the above table is the heavy total investment in these farms. The half section farms had an average investment of $20,814, while larger farms had considerably heavier investments. It is obvious that such farms constitute quite large business enterprises and necessitate the most careful and intelligent management. The interest charges alone are sufficient to absorb a considerable cash payment requiring the operator to organize his business so as to secure the largest possible income. Fortunately, much can be done along these lines as will be observed from a study of the results of this investigation.

The value of the land, as estimated by farm owners in 1929, ranged from $30 to $67.06 per acre. It is very difficult to properly appraise farm land as the value varies from year to year with the price of wheat. When wheat prices are low for a few years farm values tend to drop too low while when prices are high farm values tend to become too high. Some average figure must be adopted.

The percentage of the total farm acreage under cultivation varies widely with different farms. In two exceptional cases this percentage has ranged from 54 to almost 100 per cent of the total farm area. The average of all the farms studied has been 85 per cent. Where a large percentage of the land is not being cultivated the charge for the cultivated land is considerably increased. While it is true that the proportion of uncultivated land may be high on certain farms due to non-arable land, on other farms an appreciable acreage of good arable land which could have been worked was not being worked. Some of this land could be used for the production of grain or green feed.

The value of farm equipment forms an appreciable amount of the total investment on the farm. This equipment includes field machinery, horses, harness, tractors, separators, combines, trucks and small tools. The total value of this equipment has ranged from $4.70 to over $20 per cultivated acre. Considered on the basis of the size of the farm, the investment in equipment per cultivated acre on the farms studied in this survey, has increased up to three-quarter section farms and decreased for farms over this size. This may be explained in part, for the particular farms studied, by the fact that the three-quarter section farms happen to have a low proportion of land under cultivation and in part by the tendency on some of the half and three-quarter section farms to purchase a full complement of grain handling equipment, such as threshing equipment and a tractor in addition to field machinery and horses. The amount of equipment owned was thus often sufficient for the operation of much larger acreage than was actually being worked. This disadvantage may or may not be overcome by doing considerable custom threshing and tractor work during certain seasons. In some cases, however, the amount of custom work obtained may be insufficient to justify the ownership of this equipment on the smaller cultivated acreages.

The value of field machinery, such as cultivating machinery, ploughs, seeders, binders, wagons and small implements, but not including horses, tractors, threshers or trucks averaged on thirteen farms $3.94 per cultivated acre. It ranged from $1 to $6.56 per cultivated acre. The operating cost of this field machinery ranged from 10 cents to $1.29 per cultivated acre averaging 55 cents per acre.

The amount of equipment in some cases on farms of one section and over was similar to that owned on smaller farms but the increased size of the farm greatly reduced the investment per cultivated acre. Thus, on one two-section farm the total investment for field machinery, tractor, threshing equipment, horses and harness amounted to only $4.70 per cultivated acre. This figure indicates the possibility of greatly reducing the investment in equipment on larger farms. Further reference to the choice of equipment for various sized farms is made on page 35 of this bulletin showing some outlines of various sized farms for grain growing.

Operating Power and Seasonal Labour Used on Various Sized Farms

The amount of operating power, such as the number of horses and the size of tractor, as well as the amount of manual labour employed, constitutes an important factor in farm organization. The following table shows some of the extremes of power and months of seasonal labour found on twenty-eight farms of various sizes.

TABLE 20.—Extremes of Power and Labour used on Various Sized Farms

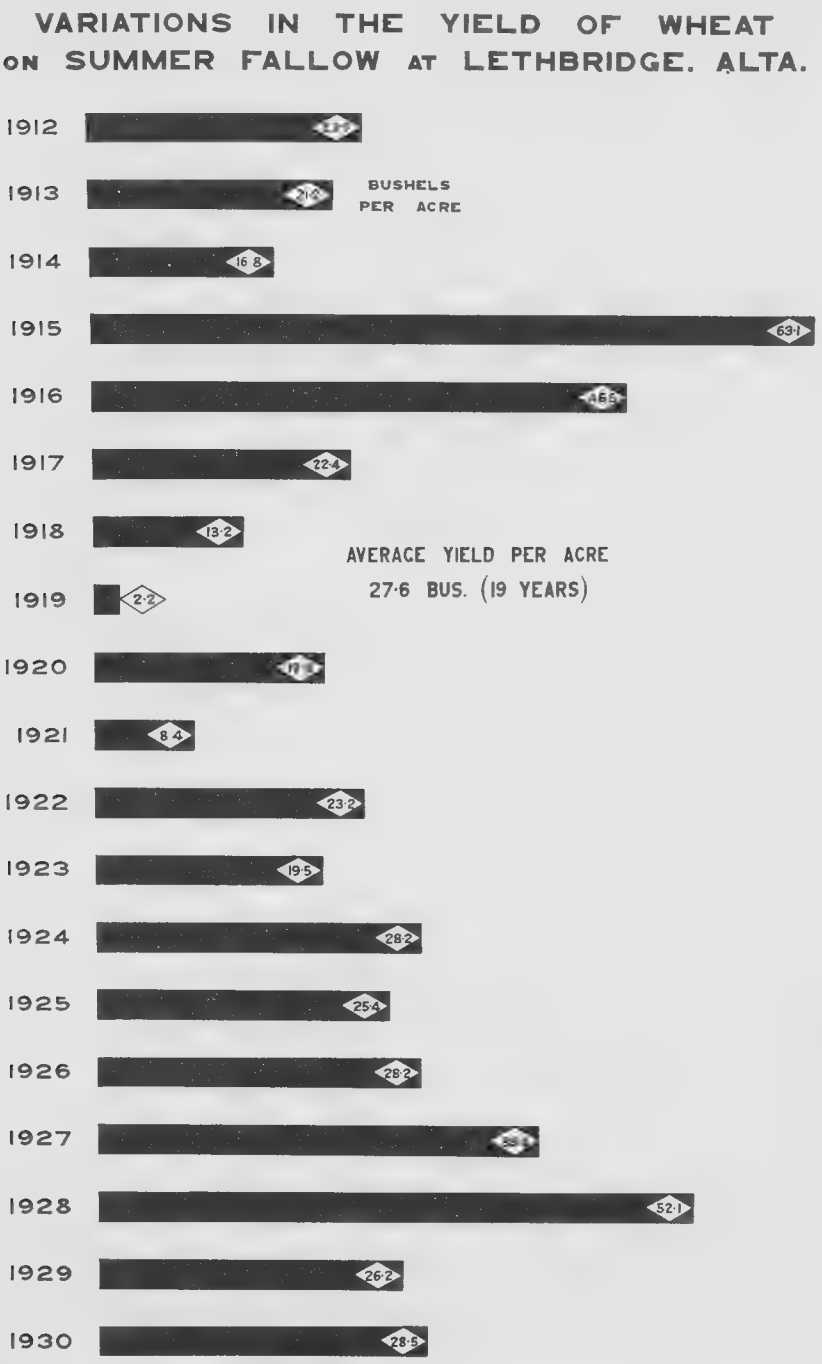
Approximate size of farm	Number records in class	Power	Horses on farm	Teams used teams x horses	Tractor D.B. H.P.	Man months seasonal labour
¼ section	2	High	8	1 x 6	.....	9
		Low	6	1 x 5	.....	8
½ section	6	High	11	2 x 5	15	14
		Low	2	1 x 2	10	7
¾ section	6	High	14	2 x 6	18	14
		Low	7	1 x 4	17	9
1 section	7	High	12	2 x 6	15	23
		Low	12	2 x 6	.....	16
1¼ section	3	High	14	2 x 6	20	16
		Low	10	1 x 4, 1x6	15	9·66
1½ section	1	.....	15	2 x 6	17	17
1¾ section	2	High	27	4 x 6	20	35
		Low	.....	.....	25	12
2 section	1	.....	2	1 x 2	20	9

The amount of horse and tractor power varied widely. Thus, among the half-section farms one farm used two 5-horse teams and a 15-horsepower tractor, while another farm with only a slightly larger acreage used only a 10-horsepower tractor and two horses for hauling. Again two 6-horse outfits and a 15-horsepower tractor were used on a one-section farm while another farm of similar size was operated with two 6-horse outfits only.

The manual labour represents the owner's estimation of the total number of man months of labour employed on his farm for crop production. This estimate was very accurate for seasonal labour but for men hired by the year the number of months of labour considered as chargeable to crops was indefinite and varied from seven to nine months per man. Failing a more precise method or detailed records, the figures given by each operator may be taken as a fair index of the labour employed on crops for each farm. Great variations exist. On two 1¾-section farms, with almost the same acreage under cultivation, 35 man months were required on one farm and on the other only 12 man months. This difference was due to the use of four 6-horse teams and a tractor on one farm while on the other all the field work was done with one tractor. At the end of the 1929 season the man who operated with four 6-horse teams sold 20 horses and planned to use tractor power.

From the data studied in this investigation it would seem that some farms were greatly over-powered and in some instances over-manned. It is not intended to criticize such farms as the present organization may be the result of circumstances over which the operator has had little control. Besides, it should be recognized that the danger of being under-powered in certain seasons may be very grave. The danger of insufficient power is that the work may be improperly done with the result that yields are reduced. However, a comparison

of the yields on the farms under consideration did not disclose any increased yields that could be attributed to greater reserve of power. In 1931 when the prices of agricultural products dropped to extremely low levels, many farmers who had a tractor as well as horses, discontinued the use of their tractor. In this way they were able to materially decrease their cash expenses. This plan



was not desirable in the case of farms operated mainly with tractor power as this would have involved additional expenditure.

Many operators expressed the opinion that the optimum size of farm for one man using a 5- or 6-horse team is one-quarter to one-half section. Using a 2-plough tractor instead of horses many thought one-half section was the most suitable size while one- and two-section farms could be handled with 3-plough and 4-plough size of tractor respectively. With two men and 6-horse teams the opinion was about equally divided in favouring one-half, three-quarters and one-section farms. With one six-horse outfit and a 3-plough tractor two men should handle, it was believed, three-quarters to one section of land. Two men with one 4-plough or larger tractor should handle two sections or more. Further information in regard to the labour and equipment necessary to handle various sized farms is given on page 35 in another section of this bulletin.

Cost of Producing Wheat in 1929 on Thirteen Privately Owned Farms

In arriving at the cost of producing wheat in this survey each farm was considered individually in order to secure all necessary data in regard to the cost of man and horse labour, tractor operation, threshing and other costs. The value of the land, including the buildings, estimated by dividing the total value by the total acreage, averaged $44.66 per acre. With interest at seven per cent the charge for the use of the land amounted to $3.13 per acre. However, areas of land on the farm which are not being cultivated materially increased the value per cultivated acre. In fact, the average value of the land per cultivated acre on these farms was $55.31, making a charge, at seven per cent interest, of $3.87 instead of $3.13 per acre. Nevertheless, inasmuch as the uncultivated land may be used for pasture and the valuations given seemed sufficiently high the latter charge has been used in these calculations. Taxes averaged 36 cents per farm acre. Seed and twine were charged at the prices given by the operators. In addition a charge was made against the cropped area for losses in the seeded acreage abandoned during the season on account of drought, soil drifting, insect damage or other cause. While this charge may prove a major and almost ruinous item of expense on certain individual farms where the damage occurs, the average charge for the entire abandoned acreage of crop in this survey amounted to only 26 cents per crop acre. No charge was made in these calculations for hail insurance for the reason that no information was available covering the amount of insurance money collected by these men over a period of years for hail losses. The cost of threshing wheat averaged approximately 10 cents per bushel. The wheat was hauled an average distance of 5·5 miles to the elevator or siding at an average cost of 2·9 cents per bushel.

Cost of Man, Horse and Tractor Labour

The average cost of seasonal man labour, including the value of the board, was $80.25 per month. On the basis of 26 working days per month this amounted to $3.08 per day but the wage ranged from $2.39 to $3.83 per day on the farms studied. The cost of day labour for harvesting and threshing operations was charged at the daily rates of wages actually paid plus a charge for board.

A very important factor in connection with the cost of manual labour is the very large proportion of this labour which is unproductive or not used directly in the production of field crops. In fact as an average covering thirteen farms, 57 per cent of the available seasonal labour considered chargeable to crops was unproductive or at least was not used directly in field crop operations. Among individual farms, this figure varied from 25 to 81 per cent of the total cost of the seasonal labour. As many of the farms were devoted solely to grain production the cost of this labour should be charged against the grain crop. When

considered as a charge against the crops this apparently unproductive labour amounted to an indirect labour charge of $1.34 per cultivated acre, as an average of all the farms, and varied from 29 cents to $2.78 per acre. It would seem that even with the most effective use of seasonal labour at least 25 per cent of the total, although not used on the crop, must be charged against it.

The annual cost of keeping horses was estimated from data supplied by the operators. It included charges for depreciation, interest, feed, harness and, in a few cases, veterinary charges. No charge was made for the labour involved in tending the horses as this was already included in the indirect labour charges. No charge was made for housing as this was included in the charge for the use of the land, which was based on the value of the land including buildings. However, the average investment in stable accommodation amounted to approximately $105 per horse.

The total cost of keeping 103 horses averaged $71.34 per horse. This figure ranged from $41.82 on one farm where the horses were used only part of the season to as much as $105.06 per horse. The number of hours worked per horse per year, including winter use, averaged 590 hours ranging from 331 to 800 hours. The average cost of horse labour, therefore, was 12 cents per hour.

The cost of tractor operation was relatively high on these farms due to their being used only 39 days per year. This made an average cost, for all sizes of tractors, of $13.95 per ten-hour day, not including the charge for the operator.

The following table gives the average cost of producing 1,967 acres of wheat after fallow on 13 farms and the average cost of producing 1,350 acres of wheat after wheat on 6 farms:—

TABLE 21.—Cost of Producing Wheat on Thirteen Privately Owned Farms in 1929

Item		Wheat after fallow	Wheat after wheat
Use of land ($44.66 per acre at 7 per cent)	$	3 13	3 13
Taxes	$	0 36	0 36
Machinery charge	$	0 55	0 55
Seed and twine where used	$	1 79	1 64
Field work	$	4 62	3 61
Indirect labour charge	$	1 34	1 34
Abandoned acreage charge	$	0 26	0 26
Share of fallow	$	5 45	2 73
Total cost per acre	$	17 50	13 62
Average yield	bush.	22·3	12·2
Cost per bushel	$	0 78	1 12

The total cost of producing wheat averaged $17.50 per acre after fallow land and $13.62 per acre for wheat after wheat. These costs include a charge for preparing the summer-fallow, the previous year, which amounted to $8.18 per acre. This summer-fallow charge has been divided in the proportion of two-thirds against the first crop after fallow and one-third against the second crop after fallow. The proportionate costs between the cost per acre of wheat after fallow and wheat after wheat are not absolutely comparable owing to there being in this particular study more farms growing wheat after fallow. A larger proportion of these farms were located in districts where costs were higher due chiefly to higher land values.

The cost per bushel of producing wheat was 78 cents for wheat after summer-fallow and $1.12 for wheat after wheat. This relatively high cost for wheat after wheat is due to the small yield of 12·2 bushels per acre which was secured in 1929 as compared with 22·3 bushels on summer-fallow land.

The above costs represent the entire farm costs plus the cost of teaming or trucking to the elevator. They differ in this latter respect from the figures covering the cost of production on the Dominion Experimental Farms, given on page 13 of this bulletin, and from those presenting the costs on the Illustration Stations given on page 23. The reader is referred to these other sources for further information on this subject.

Highest and Lowest Costs of Producing Wheat

While information on the average cost of producing wheat is of considerable value, a knowledge of what range in cost may be expected is of even greater importance. Such information may serve to indicate the most desirable farm organization for low cost of production as well as show what factors contribute to high costs. Figures are presented in the following table showing the highest and lowest cost of production per acre together with the yields obtained in 1929 and the cost of production per bushel.

TABLE 22.—Range in Cost of Producing Wheat per Acre

	Fallow	Wheat after fallow			Wheat after wheat		
	Cost per acre	Cost per acre	Yield (bush)	Cost per bushel	Cost per acre	Yield	Cost per bushel
	$	$	bush.	cts.	$	bush.	cts.
Highest cost	12 53	24 77	33·4	74	14 14	18·0	79
Lowest cost	4 85	9 52	13·6	70	7 96	12·0	66

Wide differences exist, it will be seen from the above table, in the cost of producing wheat per acre. Summer-fallow costs have ranged from $4.85 to $12.53 per acre. Wheat after summer-fallow has ranged from $9.52 to $24.77, while wheat after wheat has ranged from $7.96 to $14.14 per acre. Obviously such large differences in cost of production per acre usually result in somewhat corresponding differences in the cost per bushel. In the particular cases cited in the above table, however, the farms with the high cost per acre, happened to have also high yields per acre. This resulted in the cost of production per bushel being not very much different. Nevertheless, high costs per acre do not necessarily mean higher yields as will be seen from the following table:—

TABLE 23.—Range in Cost of Producing Wheat per Bushel

	Wheat after fallow			Wheat after wheat		
	Cost per acre	Yield	Cost per bushel	Cost per acre	Yield	Cost per bushel
	$	bush.	$	$	bush.	$
Highest cost	23 08	15·8	1 46	13 96	11·0	1 27
Lowest cost	14 82	28·0	0 53	7 96	12·0	0 66

Wheat after fallow in one instance had a relatively high cost of $23.08 per acre, as well as a relatively low yield of 15·8 bushels per acre increasing the cost to $1.46 per bushel. In another instance, however, with the cost below the average, at $14.82 per acre, and the yield above the average at 28 bushels, the result was a very low cost of 53 cents per bushel. Wheat after wheat ranged in cost from 66 cents to $1.27 per bushel due almost entirely to a reduction in the cost per acre. It is evident that the main objective is to produce the wheat at a low cost per acre and at the same time endeavour to secure a high yield.

It may be of some interest, perhaps, to outline in some detail the organization of the two cases having the highest and lowest costs of production per acre. It is not intended to be in any way critical of any operator as the high costs were due to a combination of factors perhaps beyond control. A detailed statement of the acreages handled and the man labour and power used to operate these farms may be of some value in assisting in improving the efficiency of farm organization.

The farm having the highest cost per acre of any of the farms studied consisted of 686 acres of land of which only 438 acres were under cultivation. The land was valued at $64.58 per farm acre or $101.14 per acre of cultivated land. Field machinery cost $2,315, while in addition there was $1,400 invested in a tractor and $900 in 12 horses and harness This totalled $4,615, without any investment in threshing equipment, or $10.54 per cultivated acre as compared with the lowest cost of $5.92 per acre on farms of this size. The amount of seasonal labour was somewhat high, amounting to 23 man months or seven months above the average. Due to heavy feeding throughout the year the annual cost of keeping the horses amounted to $105.06 per head as compared to the average cost of $71.34. On account of having excessive power, the horses worked on the average, it is estimated, only 535 hours per year. The horse labour cost consequently 19·6 cents per hour as compared with the average cost of 12 cents. A 15 D.B.H.P. tractor was used only 39 days per year. For the following reasons, therefore, this farm had high costs per acre: the land was valued high, there was a relatively small percentage under cultivation, the amount of equipment was somewhat excessive while the total amount of man labour and cost of horse and tractor labour was relatively high.

The average acreage covered per ten-hour day by a six-horse team on a double disk is 16.8 acres.

The farm having the lowest cost per acre of any of the farms studied consisted of two sections of land with 1,150 acres under cultivation. The land was valued at $30 per farm acre or $33.39 per acre of cultivated land. Field machinery cost $1,152, a tractor cost $1,700, a combine $2,350, and two horses with harness $200. This totalled $5,402 or $4.70 per cultivated acre. This farm was operated with nine months of seasonal labour consisting of the owner

charged for eight months and one extra man for one month during seeding. In addition day labour was hired during harvest consisting of one man to assist in operating the combine and two men with teams to haul grain.

Operating costs on this farm were very low. A 20-35 tractor was used 87 days per year at a cost for depreciation, interest, repairs, fuel and oil of $12.95 per ten-hour day. A 15-foot combine was used 29 days for the season, including eight days' custom work, at a total cost for the combine, tractor and two operators of $46.53 per day. As the combine harvested 37 acres per day the cost was $1.26 per acre. The cost of hauling grain from the combine to the elevator averaged 37 cents per acre. Field operations were combined as much as possible. A twelve-foot cultivator and a twenty-four run drill were used in combination.

Not only do costs of production vary widely from one farm to another but even within the same farm from one field to another. Thus the cost of producing wheat after wheat on two different fields on the farm previously mentioned ranged from $7.96 to $8.71 per acre but as the yields were 12 and 8 bushels per acre, respectively, the low yield being on the land with the higher acre charge, the costs varied from 66 cents to $1.08 per bushel. Much more extreme variations from field to field on other farms could be presented but these are sufficient to indicate the variable character of production costs.

The most important means of reducing the cost of growing grain, in the opinion of the operators visited, was to increase the acreage of crop per man. In order to handle this greater acreage, larger outfits were often required, combination cultural operations were necessary and the use, in some cases, of more surface cultivation and more summer-fallow. In addition, increased yields and better weed control were necessary.

FARM BUDGETS FOR ECONOMICAL WHEAT PRODUCTION

In planning any enterprise business concerns make very careful estimations of the probable net revenue likely to be secured and consider various methods of operation. The adoption of more business-like methods in farming has become necessary under the highly competitive conditions of today. The annual preparation of a carefully considered budget showing probable expenses and anticipated returns offers one means of more efficient farm planning.

A complete statement of all the items of expense together with an estimation of probable yields, can be used in the case of field crops to estimate the probable cost of production. In addition certain forms of farm organization can be projected and studied with regard to their net economy. The value of such estimations will depend in a large measure on the judgment used in their construction. The construction of an impossible case precludes the possibility of securing results of value and may lead to erroneous and damaging conclusions. With this responsibility in mind the following budgets for a number of grain farms have been prepared. They are presented as examples of the use of this method in planning investment in equipment and in the use of labour and power on grain farms of various sizes. It is possible that these outlines, with such modifications as may be necessary to fit local conditions, may prove of some value as a guide to those who plan to prepare a budget for use in the operation of their own farms. The authors are indebted to J. G. Taggart, B.S.A., Superintendent of the Dominion Experimental Farm at Swift Current, Saskatchewan, for many helpful suggestions and estimations which he has previously made in this field of work.

In working out the following outlines certain limitations have been imposed. It has been assumed that 150 acres of land are under cultivation on each quarter section. It has also been assumed that one-third of the cultivated acre-

age on each farm is in summer-fallow, that one-third is cropped to wheat after summer-fallow and that one-third is cropped to wheat after wheat or to necessary feed crops. It is not intended to convey the impression that this system of grain farming is recommended necessarily over other methods of farming. The object is simply to employ a system of farming which with some modifications is in common use and which lends itself to budget analysis.

Where horses form the source of power an area equal to three acres per horse has been allowed for the growing of feed crops, plus waste land available for pasture. The charge for the feed required by the horses is thus represented by the cost of producing three acres of feed. It has been assumed for simplicity of calculation that this acreage is cut for green feed, thus no charge has been made for threshing. If any portion of the feed crop were threshed for grain the total operating cost on the horse operated farms would be increased by an amount equal to the cost of this work.

The equipment for each farm has been chosen with a view to keeping this investment as low as possible consistent with convenience, good practice, readily available equipment, cultural methods and different types of power. The prices given are intended to be representative only and are not presented as exact costs. The value of land and buildings has been placed at $40 per acre. Interest has been charged at the rate of 7 per cent. Taxes have been placed at $58 per quarter section. Seed wheat has been calculated at $1\frac{1}{4}$ bushels to the acre, valued at 80 cents or a charge of $1 per acre. Oats for seed have been placed at 2 bushels per acre, valued at 30 cents or a charge of 60 cents per acre. In some districts the rate of seeding should be increased to $1\frac{1}{2}$ bushels per acre for wheat and $2\frac{1}{2}$ bushels of oats which would slightly alter these charges. Twine has been estimated at $2\frac{1}{2}$ pounds per acre valued at 15 cents or a charge of 37 cents per acre.

Charges for depreciation and upkeep on equipment have been variously calculated, depending on the amount of seasonal use. Interest on equipment has been figured at 7 per cent on one-half cost price of $3\frac{1}{2}$ per cent on cost price. With small usage, as on a one-quarter section farm, depreciation has been placed at $6\frac{1}{2}$ per cent, upkeep $2\frac{1}{2}$ per cent, and interest $3\frac{1}{2}$ per cent on cost price or a total of $12\frac{1}{2}$ per cent. On farms rainging in size from one-half to two sections, one rate has been applied. Depreciation has been placed at 8 per cent, upkeep at $3\frac{1}{2}$ per cent, and interest at $3\frac{1}{2}$ per cent on cost price or a total of 15 per cent. On farms of three sections, with equipment subject to a larger amount of annual use, depreciation has been figured at 10 per cent, upkeep 4 per cent, and interest $3\frac{1}{2}$ per cent on cost price or a total of $17\frac{1}{2}$ per cent. While finer distinctions as to rates of depreciation and upkeep may be desirable, simplicity of presentation has outweighed this consideration in the present instance.

The amount of seasonal labour on the various sized farms has been charged on the basis of an 8-month working period. While a 7-month working period might be equitable for certain grain farms, when such spring operations as cleaning seed and grain hauling in the fall are taken into account a working period of 8 months would appear to be fair.

Wages for seasonal labour have been estimated at $50 per month. Board and housing has been placed at $15 per month. Wages for monthly labour hired for short periods in the spring has been calculated at $65 per month, plus $15 for board. Day labour, hired for harvest operations, has been calculated at $5 per day including board.

The charge for threshing wheat has been estimated at 12 cents per bushel when hired and at cost when threshing equipment was included for the farm. For the purpose of these estimations a constant yield of wheat has been assumed;

this has been placed at 18 bushels per acre as an average. If a yield of 22 bushels per acre were assumed for wheat after fallow and 14 bushels per acre for wheat after wheat, a slight correction in yield would be necessary in some of the outlines which follow depending on the acreage in feed crops.

The assumed yield of 18 bushels of wheat per acre is a very close approximation to the average yield over a long period of years in the three Prairie Provinces. Thus, over a period of 20 years, from 1911 to 1930 inclusive, the average yield in the Prairie Provinces has been 17·4 bushels per acre. However, it is obvious that in the more favoured districts and especially with improved methods of farming this average yield should be considerably increased. In fact, on seven Dominion Experimental Farms, which may be said to be reasonably representative in regard to soil and climate but which have been farmed according to the best known methods, the average yield over the same period of twenty years has been 24.6 bushels per acre. For a shorter period of eight years, from 1923 to 1930 the yield on the Dominion Experimental Farms on a three year rotation of summer-fallow, wheat, wheat, has been 23.6 bushels per acre.

In estimating the cost per acre for wheat, on the farms given below, the total operating cost has been divided by the area in wheat. The cost per bushel has been estimated from the total operating cost and the total yield of wheat for each farm.

The amount of man labour and power indicated on these farms has been checked against normal rates of work for different sized outfits. The following cultural methods were considered in these calculations. Where mouldboard ploughs are indicated it was assumed that one-half the land to be summer-fallowed was fall disked and one-half spring disked and that the summer-fallow was ploughed once and given three cultivations. Spring work on summer-fallowed land included one cultivation or as an alternative one discing, followed by seeding. The preparation of land in stubble has been estimated on the basis that one-half is ploughed and one-half disked and that all the land is given one harrowing, followed by seeding.

Where the one-way disk was included in the equipment it was assumed that surface cultivation could be practised. Under these conditions summer-fallow would be given one one-way disking and three cultivations or as an alternative one cultivation and two rod weedings.. Spring work on summer-fallowed land would include one cultivation, followed by seeding. The preparation of land in stubble was estimated as one one-way disking followed by seeding or where stubble could be burnt one cultivation, followed by seeding. Harvesting has been estimated with the use of the binder and thresher or straight combine but not with the use of a swather.

It is realized that there are very great differences in the methods of handling land in different sections of the country. Moreover, the practices in vogue in various districts may be greatly modified from year to year by adverse weather, additional cultivation for certain weeds, treatments for insect pests, soil drifting and drought. However, the practices listed above may be taken as fairly representative of some large sections of the country in certain years. The operating time for the crews, outfits and equipment on the farms to be considered have been calculated on the basis of the above practices. No allowance has been made, however, for probable loss of time due to adverse weather conditions. With these considerations in mind the following outlines are presented.

The cost of production as shown by a budget analysis with various combinations of equipment under a cropping system of summer-fallow, wheat, wheat, is estimated below for different sized farms.

TABLE 24—Outline for a One-quarter Section Farm

Operated with	1 man, 5 horses, threshing hired
	acres
Cultivated Area—	
Summer-fallow	50
Wheat after fallow	50
Wheat after wheat	35
Feed	15
Cost of Equipment—	$
5 horses valued at $50 each, harness $20 per horse	350 00
1 14″ gang plough	150 00
1 set drag harrow	30 00
1 7-foot cultivator	100 00
1 8-foot single disk	125 00
1 grain cleaner	50 00
1 20 run drill	225 00
1 8-foot binder	290 00
1 mower $100; 1 rake $60	160 00
1 wagon gear and box	180 00
1 truck gear and rack	75 00
Total cost of equipment	1,735 00
Cost per cultivated acre	11 57
Value of land and buildings	6,400 00
Total investment	8,135 00
Annual Operating Cost—	
Use of land and buildings valued at $40 per acre at 7 per cent	448 00
Taxes $58 per quarter section	58 00
Seed wheat 1½ bush. per acre at 80 cents per bush.—$1.00 per acre	85 00
Oats 2 bush. per acre at 30 cents per bush.=60 cents per acre	9 00
Twine 2½ lbs. per acre at 15 cents per lb. = 37 cents per acre	37 00
Depreciation, interest, upkeep on equipment 12½ per cent cost	216 87
Labour cost one man 8 months wages $50, board $15	520 00
Threshing wheat, hired at 12 cents per bush., yield 18 bush	183 60
Total operating cost	1,557 47
Wheat area, acres	85
Cost per acre	$18 32
Total wheat yield, bushels	1,530
Cost per bushel	$1 02

The above outline indicates that the probable operating cost for 85 acres of wheat on a quarter section farm operated by one man and five horses with threshing hired would be $1,557.47. With a total wheat yield of 1,530 bushels the cost of production would be $1.02 per bushel. The average farm price for wheat in the Prairie Provinces from 1910 to 1931 has been $1.05 per bushel.

TABLE 25.—Outline for One-half Section Farms

Operated with	1 man, 7 horses, threshing hired	1 man, 10 H.P., tractor, 2 horses, threshing hired
Cultivated Area—	acres	acres
Summer-fallow	100	100
Wheat after fallow	100	100
Wheat after wheat	80	94
Feed	20	6
Cost of Equipment—	$	$
Horses valued at $50 each, harness $20	490 00	140 00
Tractor	.....	1,050 00
1 14" gang plough	150 00	.....
1 2-furrow tractor plough	.....	160 00
1 set drag harrows	40 00	40 00
1 9-foot cultivator	150 00	150 00
1 14-foot single disc	160 00	160 00
1 grain cleaner	50 00	50 00
1 24 run drill	310 00	310 00
1 8-foot binder	290 00	290 00
1 mower $100, 1 rake $60	160 00	.....
1 wagon gear and box	180 00	180 00
1 truck gear and rack	75 00	.....
1 truck gear for fuel tender	.....	50 00
Total cost of equipment	2,055 00	2,580 00
Cost per cultivated acre	6 85	8 60
Value of land and buildings	12,800 00	12,800 00
Total investment	14,855 00	15,380 00
Annual Operating Cost—		
Use of land and buildings, $40 per acre, 7 per cent	896 00	896 00
Taxes $58 per quarter section	116 00	116 00
Seed wheat $1.00 per acre, oats 60 cents per acre	192 00	197 60
Twine 37 cents per acre	74 00	74 00
Depreciation, interest, upkeep on equipment 15 per cent cost	308 25	387 00
Labour cost one man 8 months' wages $50, board $15	520 00	520 00
Day labour stooking, 16 days at $5	80 00	80 00
53 days fuel for tractor, 17 gals. per day 25 cents; oil 1 gallon per day $1	.....	278 25
Threshing wheat hired 12 cents, yield 18 bush	388 80	419 04
Total operating cost	2,575 05	2,967 89
Wheat area, acres	180	194
Cost per acre	$14 30	$15 30
Total wheat yield, bushels	3,240	3,492
Cost per bushel, cents	79·5	85·0

The above estimations show the suggested equipment for two one-half section farms, one operated entirely with horses and the other with a 10 D.B. horsepower tractor and two horses. It will be observed that the equipment investment on the horse operated farm has been calculated at $2,055, as compared to $2,580 on the tractor operated farm. The horse farm is represented as being operated with one six-horse team but the common practice is to keep a spare horse for each outfit.

The total operating cost has been estimated at $2,575.05 for the horse operated farm which includes the cost of producing 20 acres of feed. With a total yield of 3,240 bushels of wheat the cost would be 79·5 cents per bushel. The total operating cost on the tractor operated farm has been estimated at $2,967.89. With a yield of 3,492 bushels, due to the smaller acreage of feed and larger acreage of wheat, the cost of producing wheat has been 85 cents per bushel.

These estimations have been made on the basis of ploughing the summer-fallow and one-half the stubble land. Under these conditions it is estimated that the tractor would be used 53 ten-hour days per year. By checking these outlines against normal rates of operation for the various outfits it is estimated that the seeding of wheat could be completed on the horse operated farm about 31 days after the opening of the season for work on the land. Other preparatory cultural work included about 20 days would be required to complete the seeding of wheat on the tractor operated farm with a 24 run drill seeding 3·6 acres per hour and operated ten hours per day. Considering the total cost of operation, it is evident that some saving would be effected with the use of horses as compared to a small tractor on a one-half section farm.

TABLE 26—Outlines for One Section Farms

Operated with	2 men, 14 horses, threshing hired	1 man, 15 H.P. tractor, 2 horses, threshing hired
Cultivated Area—	acres	acres
Summer-fallow	200	200
Wheat after fallow	200	200
Wheat after wheat	160	200
Feed	40	
Cost of Equipment—	$	$
Horses valued at $50 each, harness $20	980 00	140 00
1 tractor	.....	1,300 00
2 14″ gang ploughs	300 00	.....
1 3-furrow tractor plough	.....	200 00
1 set drag harrows	40 00	40 00
1 9-ft. cultivator	150 00	.....
1 12-ft. cultivator	.....	190 00
1 14-ft. single disk	160 00	.....
1 21-ft. single disk	.....	230 00
1 grain cleaner	50 00	50 00
1 28-run drill	360 00	360 00
2 8-ft. binders	580 00	.....
1 10-ft. power binder	.....	375 00
1 mower $100, 1 rake $60	160 00	.....
2 wagon gears and boxes	360 00	.....
1 wagon gear and box	.....	180 00
1 truck gear and rack	75 00	.....
1 truck gear for fuel tender	.....	50 00
Total cost of equipment	3,215 00	3,115 00
Cost per cultivated acre	5 36	5 19
Value of land and buildings	25,600 00	25,600 00
Total investment	28,815 00	28,715 00
Annual Operating Cost—		
Use of land and buildings, $40 per acre, 7 per cent.	1,792 00	1,792 00
Taxes $58 per quarter section	232 00	232 00
Seed wheat $1.00 per acre, oats 60 cents per acre	384 00	400 00
Twine 37 cents per acre	148 00	148 00
Depreciation, interest, upkeep on equipment 15 per cent cost	482 25	467 25
Labour cost, men for 8 months wages $50, board $15	1,040 00	520 00
Day labour stooking, 32 days at $5	160 00	160 00
78 days fuel for tractor, 24 gal. per day 25 cents, oil 1 gal. per day $1	.....	546 00
Threshing wheat hired at 12 cents per bushel, yield 18 bushels	777 60	864 00
Total operating cost	5,015 85	5,129 25
Wheat area, acres	360	400
Cost per acre	$13 93	$12 82
Total wheat yield, bushels	6,480	7,200
Cost per bushel, cents	77·4	71·2

TABLE 27—Outlines for One Section Farms

Operated with	2 men, 6 horses, 15 H.P. tractor thresher owned	1 man, 15 H.P. tractor, combine and motor truck owned
	acres	acres
Cultivated Area—		
Summer-fallow	200	200
Wheat after fallow	200	200
Wheat after wheat	180	200
Feed	20	
	$	$
Cost of Equipment—		
Horses valued at $50 each, harness $20	420 00	.....
1 tractor	1,300 00	1,300 00
1 14" gang plough	150 00	.....
1 3-furrow tractor plough	200 00	200 00
1 set drag harrows	40 00	40 00
1 12-ft. cultivator	190 00	190 00
1 21-ft. single disk	230 00	230 00
1 grain cleaner	50 00	50 00
1 28-run drill	360 00	360 00
1 mower $100, 1 rake $60	160 00	.....
2 8-ft. binders	580 00	.....
1 28" separator	1,470 00	.....
1 12-ft. combine	.....	2,000 00
1 motor truck	.....	1,200 00
2 wagon gears and boxes	360 00	.....
3 truck gears and racks (fuel tender)	225 00	.....
1 truck gear for fuel tender	.....	50 00
Total cost of equipment	5,735 00	5,620 00
Cost per cultivated acre	9 56	9 37
Value of land and buildings	25,600 00	25,600 00
Total investment	31,335 00	31,220 00
Annual Operating Cost—		
Use of land and buildings, $40 per acre, 7 per cent	1,792 00	1,792 00
Taxes $58 per quarter section	232 00	232 00
Seed wheat $1.00 per acre, oats 60 cents per acre	392 00	400 00
Twine 37 cents per acre	148 00	.....
Depreciation, interest, upkeep on equipment 15 per cent cost	860 25	843 00
Labour cost, men 8 months, wages $50, board $15	1,040 00	520 00
Day labour, stooking 32 days, $5.00 per day	160 00	.....
Day labour, threshing, 8 days, 6 stook teams, $5.00 per day	240 00	.....
Day labour, combining 12 days, 1 operator $5.00, 1 truck driver $5.00	.....	120 00
65 days fuel for tractor, 24 gal. per day 25 cents, oil 1 gal. per day $1.00	455 00	.....
79 days fuel for tractor, 24 gal. per day, 25 cents; oil, 1 gal. per day, $1.00	.....	553 00
Fuel for combine ¾ gal. per acre 25 cents, oil 1 gal. per day $1.00	.....	87 00
Fuel for truck 954 miles, 14 miles per gal.; oil 4 gal. per season	.....	21 00
Truck licence	.....	15 00
Total operating cost	5,559 25	4,583 00
Wheat area, acres	380	400
Cost per acre	$14 00	$11 46
Total wheat yield, bushels	6,840	7,200
Cost per bushel, cents	77·8	63·6

The two preceding tables present four outlines of one section farms operated with different equipment. Two of these farms have been figured with threshing hired and two farms with threshing equipment owned. In the latter case no allowances have been made for probable custom work. However, in the event that custom work were not available the costs given would apply. One of the chief features brought out by these tables is the similarity of equipment investment on the farms without threshing equipment of $5.36 and $5.19 and on the farms with threshing equipment of $9.56 and $9.37 per cultivated acre.

It will be observed that the operating cost varies from $11.46 per acre with the tractor and combine to $14 per acre with the combination of horses and tractor. It is possible that an extra man for one month at $80 should be included for the farms operated with tractor only. This would increase the cost by 20 cents per acre. These relative differences in cost per acre indicate the necessity of close study in devising the most favourable combination of labour and equipment on farms of any one size.

In periods of low wages and cheap feed horse labour provides cheap power.

On the farms where threshing is hired it will be observed that there is a difference in cost of $1.11 per acre in favour of the tractor. The fact that the farms operated with horses or a combination of horses and tractor normally employ two men throughout the season as compared to the possible arrangement of one man for the season on the tractor operated farms is of equal importance. Further in regard to the net economy, it will be seen that 40 acres of land are devoted to growing feed crops on the horse operated farm and that the cost of growing this feed has been included in the total operating cost. With normal yields this acreage would represent 720 bushels of wheat. With high or even average prices for wheat this amount would probably more than pay for the fuel and oil for the tractor while with low prices this advantage would disappear, but the cost of growing an acre of feed would not be necessarily less than before. This relationship accounts for the trend towards tractors in times of high prices and the difficulty of deciding whether or not to revert to horses during periods of low prices.

The above estimates have, of course, been based on cultural practices which include ploughing. If a one-way disk could be used in the case of the tractor farm with threshing hired, the time of operation for the tractor would be reduced from 78 to 58 days. The cost per crop acre would be reduced from $12.82 to $12.42. In addition, the time required to seed the crop would probably be reduced from about 29 to 22 days after the opening of the season, using a 28 run drill in both instances and seeding 5·0 acres per hour. Similar figures for the one section tractor farm with combine and motor truck would show the probable cost

to be reduced from $11.46 to $11.02 per crop acre, and the tractor operating time from 79 to 57 days. Timeliness of seeding would be improved by several days as above.

For the farm operated with two six-horse outfits, it is estimated that wheat seeding could be completed 30 days after the opening of the season with a 28 run drill seeding 3·0 acres per hour. Using the six-horse outfit on a drill, on the horse and tractor farm, wheat seeding could be completed in 28 days if the land were ploughed and 16 days if surface cultivation were practised. The acreages of wheat for the various farms are indicated in the outlines.

TABLE 28—Outlines for Two-section Farms

Operated with	4 men, 28 horses, combine owned	1 man, 20 H.P. tractor, combine and truck owned
	acres	acres
Cultivated Area—		
Summer-fallow	400	400
Wheat after fallow	400	400
Wheat after wheat	315	400
Feed	85	
	$	$
Cost of Equipment—		
Horses valued at $50 each, harness $20	1,960 00	.....
Tractor	.....	1,700 00
4 14″ gang ploughs	600 00	.....
1 4-furrow tractor plough	.....	260 00
1 set drag harrows	40 00	40 00
2 9-foot cultivators	300 00	.....
1 12-foot cultivator	.....	190 00
2 14-foot single disks	300 00	.....
1 24-foot single disk	.....	300 00
1 grain cleaner	50 00	50 00
2 28-run drills	720 00	.....
1 24-run drill (cultivate and seed)	.....	310 00
1 mower $100, 1 rake $60	160 00	.....
1 8-foot binder	290 00	.....
1 20-foot combine	2,800 00	2,800 00
1 motor truck	.....	1,200 00
3 wagon gears and boxes	540 00	.....
2 truck gears and racks	150 00	.....
1 truck gear for fuel tender	.....	50 00
Total cost of equipment	7,910 00	6,900 00
Cost per cultivated acre	6 59	5 75
Value of land and buildings	51,200 00	51,200 00
Total investment	59,110 00	58,100 00
Annual Operating Cost—		
Use of land and buildings, $40 per acre, 7 per cent	3,584 00	3,584 00
Taxes $58 per quarter section	464 00	464 00
Seed wheat $1 per acre, oats 60 cents per acre	766 00	800 00
Twine 37 cents per acre	31 45	.....
Depreciation, interest, upkeep on equipment, 15 per cent cost	1,186 50	1,035 00
Labour cost, men 8 months, wages $50, board $15	2,080 00	520 00
Day labour, seeding 1 man 1 month, wage $65, board $15	.....	80 00
Day labour, combining 16 days, 1 operator $5, 1 truck driver $5	.....	160 00
125 days fuel for tractor, 32 gal. per day 25 cents, oil 1 gal. per day $1	.....	1,125 00
Fuel for combine, ¾ gal. per acre; oil 1 gal. per day (18 days with horses)	152 06	166 00
Fuel for truck, 1,400 miles, 14 miles per gal., oil 6 gal. for season	.....	31 00
Truck licence	.....	15 00
Total operating cost	8,264 01	7,980 00
Wheat area, acres	715	800
Cost per acre	$11 56	$9 97
Total wheat yield, bushels	12,870	14,400
Cost per bushel, cents	64·2	55·4

The above outlines for two-sections farms show one farm operated with four six-horses teams with a spare horse for each team and requiring four men for the season, while the other farm is operated with a 20 D.B. horsepower tractor and only one man for the season. The only extra labour normally required on this farm would be one man for one month during seeding and two men during harvest. It will be observed that the equipment on the horse operated farm has been calculated at $7,910, as compared to $6,900 on the tractor operated farm.

With the horse operated farm the total operating cost has been estimated at $8,264.01 and with a yield of 12,870 bushels the cost would be 64.2 cents per bushel. With 715 acres of wheat the cost would be $11.56 per acre. With the tractor operated farm the total operating cost has been estimated at $7,980 and with a yield of 14,400 bushels the cost would be 55.4 cents per bushel. On the basis of 800 acres of wheat the cost would be $9.97 per acre.

Checking these outlines against normal rates of operation for various sized outfits it is estimated that seeding could be completed on the horse operated farm, with two, 28 run drills each seeding 3·0 acres per hour, about 30 days after the opening of the season for work on the land. On the tractor operated farm using a 12 ft. cultivator and 24 run drill in combination to cover 4·0 acres per hour it would require 40 days after the opening of the saison to complete seeding of wheat, if the tractor were only operated 10 hours per day. This would indicate the advisability of operating more than 10 hours per day during seeding with the tractor equipment indicated for this size of farm, and would necessitate another man for about a month in the spring.

If surface cultivation were practised on the above 2 section tractor operated farm and the slower work of ploughing dispensed with, seeding could be completed in just over 20 days from the opening of the seasons for operation on the land. In addition it is estimated that with ploughing eliminated the operating time for the tractor would be reduced from 125 to 76 ten-hour days per year and the cost from $9.97 to $9.42 per acre or 52.3 cents per bushel.

The above 36-foot combination cultivates and seeds over 100 acres per day, placing the seed in moist soil. For the most economical use it should be operated both day and night.

TABLE 29—Outlines for Three-Section Farms

Operated with— Working 20 hours per day for spring work 16 hours per day for summer 10 hours per day for harvest	2 men, 20 H.P. tractor, combine truck owned. Land ploughed	2 men, 20 H.P. tractor, combine, truck owned. Surface cultivation (one-waydisk)
	acres	acres
Cultivated Area—		
Summer-fallow	600	600
Wheat after fallow	600	600
Wheat after wheat	600	600
Cost of Equipment—	$	$
1 20 D.B.H.P. tractor	1,700 00	1,700 00
1 4-furrow tractor plough	260 00	.....
1 10-ft. one-way disk	.....	280 00
1 set drag harrows	40 00	40 00
1 24-foot single disk	300 00	.....
1 grain cleaner	50 00	50 00
1 12-foot cultivator, 1 24-run drill, 2 12-foot rod weeders used in combination	190 00 310 00	190 00 310 00 240 00
1 20-foot combine	2,800 00	2,800 00
1 motor truck	1,200 00	1,200 00
1 truck gear for fuel tender	50 00	50 00
Total cost of equipment	6,900 00	6,860 00
Cost per cultivated acre	3 83	3 81
Value of land and buildings	76,800 00	76,800 00
Total investment	83,700 00	83,660 00
Annual Operating Cost—		
Use of land and buildings, $40 per acre, 7 per cent	5,376 00	5,376 00
Taxes $58 per quarter section	696 00	696 00
Seed wheat $1 per acre	1,200 00	1,200 00
Depreciation, interest, upkeep on equipment, 17½ per cent cost	1,207 50	1,200 50
Labour cost, 2 men 8 months, wages $50, board $15	1,040 00	1,040 00
Day labour, seeding, 1 man 1 month, wages $65, board $15	80 00	80 00
Day labour combining 24 days, 1 truck driver $5	120 00	120 00
187 10-hour days fuel for tractor, 32 gal. per day 25 cents, oil 1 gal. per day	1,683 00	.....
114 10-hour days fuel for tractor, 32 gal. per day 25 cents, oil 1 gal. per day	.....	1,026 00
Fuel for combine ¾ gal. per acre, oil 1 gal. per day $1	249 00	249 00
Fuel for truck 2,100 miles, 14 miles per gal., oil 8 gallons for season	45 50	45 50
Truck licence	15 00	15 00
Total operating cost	11,712 00	11,048 00
Wheat area, acres	1,200	1,200
Cost per acre	$9 76	$9 21
Total wheat yield, bushels	21,600	21,600
Cost per bushel, cents	54·2	51·1

The above farm outlines have been based on the use of a double labour shift with the object of operating at least 20 hours per day during the rush period in the spring, 16 hours per day during the summer and 10 hours per day during harvest. This method has been tried out in a limited way by some operators and to a larger extent by other operators when pressed for time due to adverse weather conditions. Some men who have tried night shifts for this purpose expressed the opinion that the practice would be unsatisfactory as a normal method of working due to the fact that more time was lost on the night shift than during the day time. Other operators were of the opinion that the double shift system is entirely feasible with tractor power and adequate lighting. Probably the chief claim that can be made for the system is that overhead on equipment may be reduced and that a larger acreage can be handled with the equipment thus tending to reduce the cost. As against these possible advantages the greatest disadvantage is likely to be the uncertainty of completing seeding on time in the event of adverse weather conditions.

In these outlines the same equipment has been included as was suggested for the two-section tractor operated farms. Three sections of land have been chosen rather than four sections as it would appear that more than 10 hours per day would be required on the 2 section farm during seeding. In addition it was thought advisable to allow some margin of safety with night operation for adverse weather conditions. As will be seen the increased acreage would materially reduce the per acre investment in equipment. It is also estimated that the cost per crop acre could be reduced to $9.76 or 54.2 cents per bushel when ploughing is practised and to $9.21 per crop acre or 51.1 cents per bushel when a one-way disk is used. A study of the various items of cost shows that an additional man has been included on these farms for the night shift. It is possible that an extra man should also be included during seeding. However, another $80 wages for help during seeding would only increase the cost by about 6 cents per acre.

By checking these outlines against normal rates of operation it has been estimated that when ploughing is practised the tractor would be operated the equivalent of 187 ten-hour days per season, while if the one-way disk were used the tractor would be operated the equivalent of 114 ten-hour days. Providing adverse weather conditions were not encountered and equipment operated up to schedule seeding could be completed, at the rate of 4·0 acres per hour, some 31 days after the opening of the season on the farm with ploughs and some 17 days after the opening of the season on the farm with surface cultivation, other operations included.

Deciding Factors in the Choice Between a Two- and Three-Year Rotation

For a number of years there has been considerable discussion in certain parts of the Prairie Provinces as to the advisability of changing from the common three-year rotation of summer-fallow, wheat, wheat to the system of alternate summer-fallow and wheat. The chief deciding factor is the yield. After yield the major deciding factors are available equipment and labour, operating methods, and the price of wheat. In addition there are the factors of available land, the possible greater assurance of a crop after fallow and the effect of more frequent fallow on soil drifting, weeds and insect control.

Available labour and equipment will determine the extent of the acreage than can be handled with either system as well as influence the cost of production. The crop production methods employed will likewise influence the cost. With the same total cultivated acreage there would be a smaller acreage in crop with the two-year rotation, thus the total amount of seed and the total cost of harvesting would be less. With expensive methods of harvesting this difference would be relatively large while with inexpensive methods this difference might be considerably reduced.

The yield of wheat will be the main deciding factor between these rotations. Where the yield of wheat on ploughed stubble is more than one-half that after summer-fallow the three-year rotation will produce more bushels of grain than the two-year rotation. Where it is possible to determine the saving in cost for the smaller acreage of crop with the two-year rotation due to the smaller total amount of seed required, the smaller acreage of crop to harvest and possible differences in the cost of cultural operations, the sum of these savings may be compared with the possible increase in the total yield for the longer rotation. With high prices the value of the increased yield may exceed the cost of handling the additional acreage of crop, while at lower prices this value may be less than the estimated saving with the smaller acreage.

Comparison of Actual Farms with Budget Analysis Results

The results of the various budget analyses are intended primarily to be comparable estimations due to the fact that the rates for use of land, labour and materials have been the same for all estimations. The exact figures secured cannot be expected to apply, therefore, under all circumstances but should be

modified according to local conditions. However, a comparison of the estimated costs per acre by the budget analysis method with the results obtained on some of the actual farms referred to in the section dealing with the "Cost of Producing Wheat on Certain Private Farms" indicates that there is a fairly close agreement in some instances when the value of the land is considered on the same basis. Moreover, this agreement included farms varying from one-half to two sections in extent and were among the most efficient of a number of private farm studies.

FARM MACHINERY OPERATING COSTS IN THE PRAIRIE PROVINCES

In order to secure reliable information regarding the average investment and operating cost of farm machinery, a questionnaire was sent in 1925 to representative farmers in the Prairie Provinces. The replies which were received have given very useful information relating to the average life of the various implements, the amount of money invested in machinery on farms of various sizes, and the annual cost of the machinery per acre of cultivated land. Some 678 replies were received from the three Prairie Provinces. It is impossible to say, even with this large number of replies, that the findings will be absolutely representative, although they should approach this very closely. It should be remembered, also, that the figures presented are average figures and that extremes occur in each direction from these averages.

The following table shows the average life of the various farm machines:—

TABLE 30—Average Length of Life of Farm Machines

Kind of machine	Length of life
	years
Automobile	9·5
Buggy	14·4
Corn-binder	13·2
Corn-cultivator	17·1
Corn-planter	14·7
Cultivator	15·3
Cutter	12·9
Disk-harrow	15·6
Fanning-mill	16·6
Gasolene engine	12·0
Grain-binder	12·7
Grain-drill	15·1
Harness	13·5
Hay-fork	17·4
Hay-loader	12·9
Hay-rake	17·2
Hay-rack	7·3
Manure-spreader	13·1
Motor truck	8·9
Mower	14·3
Other machinery	13·1
Packer or roller	20·0
Plough-gang	15·6
Plough-sulky	15·5
Plough-walking	19·4
Potato-digger	17·3
Potato-planter	14·1
Potato-sprayer	12·5
Silage-cutter	16·1
Sleigh	18·5
Spike-tooth harrow	18·0
Sweep rake	11·8
Tedder	18·1
Threshing machine	12·9
Tractor	11·4
Wagon	20·1
Average life	14·7
Rate of depreciation (per cent)	6·8

The foregoing figures, secured on farms having an average of 338 acres under cultivation, will afford a very useful reference regarding the length of life which may be expected from various farm machines. With care, this lifetime may be prolonged, while, on the other hand, excessive usage or careless handling will undoubtedly shorten the life below the figure given.

The annual cost of farm machinery includes depreciation, interest, repairs and housing. The depreciation is based on the average life of the various machines and as the average value given in this survey is for machinery of all ages, it is assumed that the machinery at present on these farms has, on the average, completed half of its life. Therefore, the value on which the depreciation is reckoned should be twice that of the inventory value given in this survey. The interest has been figured at 8 per cent of the inventory value of the machinery. The repairs comprise the cost of repair parts, while the housing charge includes the annual cost of the building in which the machinery is stored. The total amount of these charges vary with the amount of the machinery which is owned and with the care which is used in operating it. The cost of the machinery per acre of cultivated land depends to a large extent upon the number of acres in the farm under cultivation.

The following table shows the average annual cost of the farm machinery on a number of selected farms in the Prairie Provinces. These figures include those farms where general machinery only is owned; they do not include farms where tractors, trucks, and automobiles are owned. The figures which are given, therefore, are applicable only for farms where there is no special machinery; it is clear that where there are any of these machines, the cost would be increased proportionately above these figures.

TABLE 31—Annual Operating Cost of Farm Machinery

Item	Prairie Provinces
	$
Average inventory value of machinery per farm	830 19
Investment in machinery shed	189 26
Number of acres cultivated	204
Depreciation	112 91
Interest on investment	66 42
Repairs	80 17
Housing	17 02
Total annual cost	276 52
Cost per acre of cultivated land	1 35

The annual operating cost of general farm machinery per acre of cultivated land on these farms was $1.35 per acre. These figures showing the annual cost of farm machinery are the average covering a large number of farms; it should be borne in mind that each individual farm has a separate cost depending upon the amount of machinery owned, the care which is exercised in handling it, and upon the number of cultivated acres in the farm. The influence of an increase in acreage is shown in the section "Farm Organization for Grain Production" where the operating cost of field machinery varied from 10 cents to $1.29 per cultivated acre and averaged 55 cents per acre for a group of farms with 561 acres under cultivation.

The great majority of farmers owned some special machinery such as a tractor, truck, automobile, or threshing outfit. Taking the average of all reports received from farmers, some of which had no special machinery while others had one or more special machines, the average annual cost of machinery per

A small combine with pick-up attachment being operated by an eight-horse team.

acre of cultivated land was $2.09 in the Prairie Provinces. This latter figure, however, does not apply to any particular amount of machinery on a farm but to the average amount of machinery on all the farms examined.

Wide variations occur between individual farms in the amount of machinery owned. While the average investment in general machinery was valued at $4.07 per acre of cultivated land, one farmer had an investment of $28.97 per acre. It will be seen, therefore, how wide the variations are in the amount of machinery owned on different farms. The kind and amount of machinery owned may very materially reduce the expense of manual labour. Care in operating and repairing machinery may greatly prolong its life, but there finally comes a time when the expense for repairs becomes excessive and the delay and losses in doing field work necessitates the purchase of new machinery. The introduction of farm machinery, along with the development of scientific agriculture, has made it possible for the Canadian farmer to compete successfully with many foreign countries where the cost of labour and the cost of living are very much below Canadian standards. It is very economical to use large, labour-saving machinery whenever the size of the farm will warrant its purchase. The chief factor influencing the cost of farm machinery is the number of acres under cultivation. Within certain limits, the larger the acreage the lower the cost. Repairs are an important charge against machinery, which suggests that care in handling, oiling, and tightening bolts, afford the best means of reducing costs.

THE FARM TRACTOR

Owing to the increasing importance of the tractor as a source of farm power, it was decided to secure extensive information with respect to its advantages and disadvantages, work covered per day, daily operating cost and relative cost of doing various field operations as compared with horses. This information was secured in 1930 by means of questionnaires sent to a large number of representative tractor owners in the three Prairie Provinces. As 405 replies were received considerable useful information was obtained. This investigation of the farm tractor in 1930 supplements a somewhat similar study made in 1926 by the Dominion Experimental Farms.

Advantages of the Tractor

The most important advantage of the tractor is its ability to get work done on time. More tractor owners listed this advantage than any other. The tractor is particularly valuable in getting ploughing, cultivating and seeding done promptly. Where a combined reaper-thresher is operated, a tractor is almost invariably employed to haul it, in which case the tractor is also used for many other farm operations. It is interesting to observe that 170 out of the 405 tractor owners operated combined reaper-threshers. The next most important advantage consists in the reduction in hired labour which has ranged from 6.5 man-months for 2-plough tractors to 17.0 man-months for over 4-plough tractors. This is a considerable saving especially during periods of labour scarcity and high wages. The possibility of working a greater number of hours per day, or even double shifts in rush seasons, makes possible the operation of larger acreages at smaller costs.

Other advantages mentioned by tractor owners include belt work, and revenue from custom work. While custom work constituted 12.5 per cent of all work done, in another survey made in 1925 it amounted to 25.0 per cent. In extremely dry districts less trouble is experienced through scarcity of feed and water. Where virgin land remains to be broken, the tractor is very useful for this purpose. If frequent cultivations are necessary for weed control the tractor has proved very effective, especially in hot weather.

The chief disadvantage cited against the tractor in this survey was the present low price of grain. If the study had been made in 1931 instead of in 1930 this opinion would have been even more pronounced. It would seem that when the price of grains is below the cost of production the less cash outlay the better. The high cost of fuel and oil was mentioned as a serious objection by many owners. The original cost of the tractor, as well as the expensive overhead and depreciation charges, was stated to be too high. Other causes of dissatisfaction consisted in having farms too small to justify the use of a tractor, unsuitable land for its operation or unwise choice in the type of tractor purchased.

Out of the 405 tractor owners who supplied information, 79 per cent considered their tractor a paying investment, 15 per cent did not regard it as profitable while 6 per cent were doubtful. About one-half of those who stated that their tractor was not profitable in 1930 claimed that the reason for this was the low price of grain. With higher grain prices, therefore, a larger percentage might have regarded it as profitable but with lower prices, fewer owners might have supported it.

Effect of Tractor on Number of Horses

In the great majority of instances, the purchase of a tractor has resulted in the displacement of a number of horses. It resulted, also, in increasing the acreage of land under cultivation. The extent of these changes, arranged so as to show the effect of different sized tractors, is given in table 32. This table does not refer to new farms which have commenced operations with tractor power or to farms where more than one tractor is owned. It gives information covering farms where one tractor was owned in order that the effect of one machine on the reduction of horses and the increase in acreage would be more accurately determined. As there were 295 of these farms, however, out of the total of 405 farms studied, it is believed that the data are fairly reliable.

TABLE 32—Average Number of Horses and Size of Farm Before and After the Purchase of a Tractor

Size of tractor	Before purchase		After purchase		Changes		
	Cultivated acres	Horses	Cultivated acres	Horses	Increase in acreage	Actual reduction in horses	Real reduction in horses
2-plough	275	8·4	356	3·8	81	4·0	6·5
3-plough	393	12·0	523	6·9	130	5·3	9·3
4-plough	485	13·4	645	7·5	160	5·9	10·4
Over 4-plough	697	15·7	979	5·7	282	10·0	16·8

It will be seen from the above table that there has been a very significant increase in the cropped acreage after the purchase of the tractor, especially with the larger sized tractors. With 2-plough tractors there has been an average increase of 81 acres per farm while, with 4-plough tractors, 160 additional acres have been handled. This increase in acreage affects the real reduction in the number of horses inasmuch as more horses would have been required to handle this additional acreage if no tractor had been purchased. The real reduction in the number of horses, therefore, includes the number of horses actually disposed of, plus the number that would be necessary to perform the additional work entailed in farming the increased acreage. Thus, with the 4-plough tractor, there has been an actual reduction of 5.9 horses but, considering the increased acreage handled, there has been a real reduction of 10.4 horses.

Tractor owners have claimed that they are now able to do their work in less time. When asked how many horses would be needed to do their present amount of work in the same length of time if they were to dispose of their tractor, the 2-plough tractor owners said 10.8 horses, 3-plough 17.9 horses, 4-plough 20.6 horses, and over 4-plough 25.1 horses. By comparing these figures with those in the last two columns of the above table, it will be seen how great has been the effect of the tractor in reducing the number of horses. Taking the entire group of 295 owners of one tractor there was a total reduction in the number of horses from 3,569 before the purchase of the tractor to 1,999 after its purchase, or an actual reduction of 1,570 horses. However, to do their present work in the same time in the event they were to dispose of their tractor, they estimated that 5,087 horses would be required. Besides, there was a reduction in hired labour of 2,339 man-months, which means an elimination of 2,339 men for one month, 390 for six months, or some other equivalent reduction.

Horseless Farms

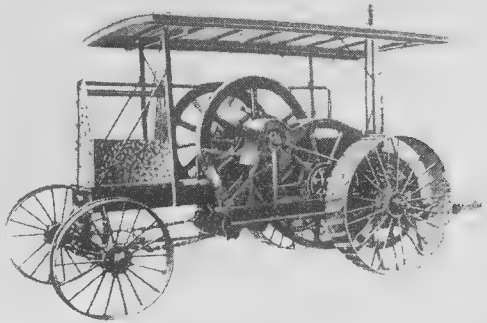
On a considerable number of farms all horses had been disposed of since the purchase of a tractor. A total of 58 tractor owners, or 14 per cent of the 405 men who supplied information in this investigation, were farming without horses. Thirty-eight of these men used only one tractor and in order to study the effect of one machine on the reduction of horses and the increase in acreage, figures are presented for these tractor owners only. The following table shows the effect of this change from all horse operation to all tractor operation in increasing the cropped acreage and in reducing the number of horses and the amount of hired labour.

TABLE 33—Effect of Tractor in Increasing Acreage, Reducing Number of Horses and Amount of Hired Labour

Size of tractor	Number in group	Before purchase of tractor		After purchase of tractor			
		Cultivated acres	Horses	Cultivated acres	Increase in acreage	Real reduction in horses	Reduction in hired labour man months
2-plough	7	232	7·0	239	7	7·2	7·4
3-plough	16	355	11·2	640	285	20·2	12·6
4-plough	12	366	10·3	648	282	18·3	11·7
Over 4-plough	3	640	14·0	1,013	373	20·9	18·7

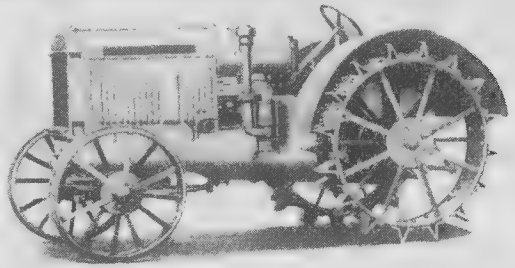
After the disposal of all the horses, there was a considerable reduction in the amount of hired labour. With the 3-plough tractor farms, there was a reduction of 12·6 man-months. With average farm wages this reduction would mean considerable saving. As the number of acres under cultiatvion was increased after the purchase of the tractor and the disposal of the horses the real reduction in horses was considerably greater than the actual number formerly used. Three of the fifty-eight horseless farmers stated that the tractor was not profitable in 1930 owing to low grain prices and two objected to the high cost of fuel and oil. It is somewhat premature and not the function of this bulletin to forecast the probable future development of horseless farms in grain growing regions but it would seem wise to follow carefully the comparative cost and efficiency of this method.

1906



1 CYLINDER. FRICTION DRIVE.	20 H.P.
ENGINE SPEED	240 – 290 R.P.M.
ROAD SPEEDS	1.79 – 2.16 M.P.H.
WEIGHT	13,500 LBS.

1929



4 CYLINDER (VERTICAL)	McC.-D. 22-36
ENGINE SPEED	1,050 R.P.M.
ROAD SPEEDS	2½, 3¼, 3¾ M.P.H.
WEIGHT	6,540 LBS.

Twenty-three years' progress in the development of the tractor.

Trend of Tractor Sizes

It is useful to study the trend in the size of tractors over a period of years, especially the prospective future trend. In order to obtain information on this point owners were asked what size of tractor they would prefer if buying again. The following table shows both the size of the tractors now owned and also what changes would be made by owners of the various sized tractors:—

TABLE 34—Trend of Tractor Sizes

Size of present tractor	Number owners reporting	Size of future tractor			
		2-plough	3-plough	4-plough	Over 4-plough
2-plough	23	14	5	4	0
3-plough	226	2	151	70	3
4-plough	103	4	10	85	4
Over 4-plough	12	0	0	1	11

The large majority of men giving information in this survey owned 3-plough and 4-plough tractors. Only a few 2-plough tractors were in use indicating that this size is not very much in favour in grain growing regions. Large tractors, over the 4-plough size, were also few in number.

It is important to observe that 70 of the 226 owners of 3-plough tractors would buy the 4-plough size if buying again. Most of the 4-plough owners would continue with their present size.

Size of Farm Necessary to Justify Purchase of a Tractor

With regard to the smallest size of farm which would justify the purchase of a tractor, owners of 2-plough tractors thought that approximately 300 acres of cultivated land would be the minimum. Owners of 3-plough and 4-plough tractors thought that slightly over 400 acres would be necessary. Actually, however, as will be seen by reference to table 32, these men are farming much larger acreages than this minimum. As will be seen by reference to the chapter in this bulletin entitled "Farm Budgets for Economical Wheat Production" in the outlines of one-half section farms on page 36, the half section farm may be operated by horses at slightly less cost than with a tractor. When the size of the farm is increased beyond this, however, the use of the tractor may be more profitable.

The Cost of Operating a Tractor

The cost of operating a tractor includes two main and somewhat distinct items, namely, fixed or overhead cost, and the direct operating cost. The latter includes fuel, oil, grease and the wages of the operator. The fixed charge includes depreciation, interest, repairs, and repair labour. In order to determine the daily cost of operating the tractor, the total fixed or overhead charges for the year should be divided by the number of days of work the tractor does annually; to this figure must then be added the direct operating costs of fuel, oil, grease, and the wages of the operator. It will be seen that if the tractor is used only a few days per year, the fixed or overhead charges per day will be very high, because these charges do not change with increasing amounts of work except to a slight extent in so far as repairs are concerned. However, if the tractor is operated a large number of days per year the daily overhead charge becomes greatly reduced.

The charges for fuel, oil and grease are the average prices for 1930. The average price of gasolene and kerosene was, respectively, 26·6 and 26·1 cents

per gallon. The average price of distillate was 16·7 cents per gallon and with such a difference there was an increased use of this fuel. To counterbalance the saving in the cost of the fuel, however, there was an increased expense for oil and repairs but even with these deductions there remained a substantial saving. Nevertheless, as these tractors had not operated long enough on distillate to experience its full effect, it is impossible from the data secured to decide what price differential would warrant its use.

The following table gives a detailed statement of the various items of expense in operating a tractor. Owing to the large number of records, especially with the 3-plough and 4-plough tractors, it is believed that this information is particularly reliable. The group of over 4-plough tractors, including sizes from 25 to 50 horse-power and ranging in price up to $5,900 has not such specific reference to any particular size of tractor as those in the 2-, 3- and 4-plough groups.

TABLE 35—Cost of Operating a Tractor

——		2-plough	3-plough	4-plough	Over 4-plough
Number of tractors in group		26	247	119	13
Average estimated life in years		9·4	9·9	9·5	11·1
Rate of depreciation in per cent		10·6	10·1	10·5	9·0
Average cost new	$	810 65	1,374 00	1,661 60	3,560 00
Average age in years		3·6	3·0	2·6	2·5
Average present value	$	512 60	897 38	1,063 27	2,425 00
Daily fuel consumption	gals.	16·6	21·5	25·9	35·0
Daily oil consumption	qts.	2·2	3·1	3·8	4·1
Daily grease consumption	lb.	0·6	0·8	1·2	1·5
Yearly depreciation charges on cost price	$	85 93	138 77	174 47	320 41
Interest 7 per cent on ½ cost price	$	28 37	48 09	58 16	124 60
Average annual repairs 2½ per cent on cost price	$	20 25	34 25	41 54	89 00
Hired repair labour at 50 cents per hour	$	1 50	2 10	2 20	2 50
Home repair labour at 25 cents per hour	$	2 95	3 53	3 95	4 70
Total annual overhead	$	139 00	226 74	280 32	541 21
Average No. 10-hour days used per year		59·8	69·7	78·3	87·7
Average daily overhead = total overhead ÷ number days used	$	2 32	3 25	3 58	6 17
Average daily fuel cost at 26·25 cents per gal	$	4 36	5 64	6 80	9 19
Average daily oil cost at $1.11 per gal	$	0·65	0 84	1 06	1 15
Average daily grease cost at 16 cents per lb	$	0 12	0 14	0 16	0 22
Tractor cost per 10-hour day	$	7 45	9 87	11 60	16 73
Daily cost of operator	$	2 50	2 50	2 50	2 50
Total cost of drawbar work per day	$	9 95	12 37	14 10	19 23

It will be seen from the above table that the total cost of operating a 2-plough tractor is $9.95, for a 3-plough tractor $12.37, a 4-plough tractor $14.10 and for tractors over 4-plough in size $19.23 per day. These costs include a charge of $2.50 per day for the wages of the operator. The method presented in this table may be used as a guide in order to reckon the cost of operating any particular tractor.

The number of days which the tractor is used per year has a very important effect on the daily cost of operation. Taking the 3-plough tractor as an example it will be seen that the total annual overhead for depreciation, interest and repairs amounts to $226.74. As the tractors in this group worked on the average 69·7 days per year, the average daily overhead was $3.25. However, if the

tractor were used only one-half this number of days the daily overhead would be double this amount. Obviously it pays to provide as much useful work as possible for the tractor in order to secure the most economical operation.

The average daily consumption of fuel, oil and grease is presented in the above table for the different sized tractors. The 3-plough tractor used per ten-hour day 21·5 gallons of fuel, 3·1 quarts of oil and 0·8 of a pound of grease. While this study does not enable an exact comparison between the relative consumption of gasolene and kerosene, tractor owners reported less than one gallon per day difference between these two fuels. The great majority used gasolene.

The figure given for average repairs of $2\frac{1}{2}$ per cent of the cost price is an estimated figure and not that actually obtained from these particular tractors. Actually a much smaller figure was reported by the tractor owners. In fact the real cost for repair parts was only about one-third of that presented on the basis of $2\frac{1}{2}$ per cent of the cost price of the tractor. However, as the average age of all the tractors in this survey was only 2·9 years, it is obvious that the repair costs reported by owners were lower than would be the case over the normal life of the tractor. For this reason, the annual repair costs were ascertained for those tractors which were five or more years of age. The repairs for these tractors amounted to approximately 2·5 per cent of the initial cost of the tractor. It is believed that this amount is an equitable charge although some authorities have used a figure of 4 per cent. In this bulletin an annual repair charge of 2·5 per cent of the cost price of the tractor has been employed. Repair labour does not constitute an important item but where this has been hired it has been charged at 50 cents per hour while home labour, both for repairs and operation has been charged at 25 cents per hour.

Comparative Cost of Field Operations with Horses and Tractors

It is becoming increasingly important to determine the comparative cost of doing field work with horses and tractors. At the present time the great majority of farmers operate with horses alone, a considerable number use a tractor along with horses, while a few use the tractor alone without any horses. Sufficient information is not available to make a comparison among these various methods of supplying farm power but considerable data are available to compare the acreages which are ordinarily covered per 10-hour day with horses and with tractor and the comparative costs of various field operations. It should be remembered that the amounts of work done per day by the various outfits are average figures and are subject to change under varying conditions. They are, however, the average of several hundred cases and should be fairly reliable. They are offered only as guides and may be altered to suit each different condition.

In computing the cost of operation for 1930, horse labour has been charged at 80 cents per ten-hour day and manual labour at $2.50 per day. It is difficult to know exactly what cost per hour should be used for horse labour on account of the wide variation on different farms in regard to the expense of keeping horses as well as in the number of days per year the horses work. If it is desired to change this cost in order to cover different circumstances this may easily be done. Some estimates showing the effects of the low rates of manual and horse labour are presented at the end of this section. The following tables show the acreages covered per 10-hour day and the 1930 costs per acre exclusive of implement costs, with four, six and eight-horse teams as well as with various sized tractors.

TABLE 36—Acreages Covered Per 10-Hour Day

Operation	Horses			Tractor			
	4-horse team	6-horse team	8-horse team	2-plough	3-plough	4-plough	Over 4-plough
Ploughing stubble	4·5	4·8	7·6	8·1	12·6	15·7	27·1
Ploughing sod	1·9	3·6	4·6	5·7	7·6	8·9	13·1
One way disking	.....	.....	10·0	.....	26·6	32·2	.....
Disking—single	13·7	20·3	30·5	33·1	62·1	72·9	88·0
Disking—tandem	8·2	14·9	16·8	27·9	34·4	35·7	58·0
Cultivating	13·1	16·5	20·1	30·0	35·0	37·5	90·5
Rod weeding	.....	23·0	28·0	35·0	47·5	64·4	101·0
Harrowing	31·8	42·5	63·0	66·5	98·7	123·0	162·0
Seeding	19·2	25·4	33·5	33·3	42·0	55·2	90·0
Binding	17·4	.....	.....	26·8	30·3	31·6	.....

TABLE 37—Cost Per Acre (1930 Costs)

Operation	Horses			Tractor			
	4-horse team	6-horse team	8-horse team	2-plough	3-plough	4-plough	Over 4-plough
	$	$	$	$	$	$	$
Ploughing stubble	1 27	1 52	1 17	1 23	0 98	0 89	0 71
Ploughing sod	3 00	2 03	1 94	1 75	1 63	1 58	1 47
One way disking	.....	.....	0 89	.....	0 47	0 44	.....
Disking—single	0 41	0 35	0 29	0 30	0 19	0 19	0 21
Disking—tandem	0 68	0 49	0 53	0 32	0 36	0 40	0 33
Cultivating	0 43	0 44	0 44	0 33	0 35	0 38	0 21
Rod weeding	.....	0 31	0 42	0 28	0 26	0 21	0 19
Harrowing	0 18	0 17	0 14	0 14	0 12	0 11	0 12
Seeding	0 30	0 28	0 27	0 30	0 30	0 25	0 21
Binding	0 31	.....	.....	0 37	0 40	0 44	.....

The acreages covered per 10-hour day are considerably larger with the tractor than with horses. This is particularly the case with the larger sized tractors. The 4-plough tractor, covering 15·7 acres per day, ploughs about three times as much as the 6-horse team and twice that of the 8-horse team. With regard to other field operations, as will be seen from the above table, the 4-plough tractor averaged about twice as much work as the 8-horse team and substantially larger proportions when compared with the 6 and 4-horse teams. In fact the 4-horse team does only from one-third to one-fifth of that done by a 4-plough tractor. The 3-plough tractor, as would be expected, covers somewhat less acreage than the 4-plough size, while the large tractor, over 4-plough in size, performs a considerably greater amount of work. The 2-plough tractor does not cover a much greater acreage than the 8-horse team which no doubt is responsible for the trend towards larger sized tractors. No comparison between horses and tractors is available on the operation of the combined reaper-thresher as this machine was hauled entirely by tractor power. The acreages covered per day with this machine will be found on page 68 in another section of this bulletin entitled "The Normal Day's Farm Work."

An outstanding advantage for the tractor is shown in its use with the one-way disk for ploughing. This implement utilizes the maximum capacity of the tractor and does work under many conditions quite the equal of that done with the mouldboard plough. It covers twice the acreage of that done with the mouldboard plough at one-half the cost. Comparing mouldboard ploughing with a 6-horse team, a 3-plough tractor on a one-way disk covers almost six times the acreage at one-third the cost. For every 100 acres this means a saving of 17 days and $99 in the cost of this operation. It is true that for some

operations, like summer-fallowing, additional operations may be required to equal mouldboard ploughing but it is certain that for certain conditions this implement has many advantages.

No doubt some of the acreages covered by tractors could be increased by the use of implements of a width commensurate with the capacity of the tractor. The use of small equipment with tractors has in many cases reduced the acreage per day much below the actual capacity of the tractor. Another point not included in the figures in the above table, is the ability of the tractor to work longer hours than a ten-hour day, even operating double shifts if desired thereby considerably increasing the acreage which may be handled as compared with that possible with horses.

The one-way disc plough can be used to speed up stubble and summer-fallow operations. A nine-foot one-way disc will cover three acres per hour.

The comparative cost per acre with horses and tractors shows that for heavier operations like ploughing, disking and cultivating, the tractor effects considerable saving. For lighter work, however, such as harrowing and seeding, there was not much difference in cost, while for binding horses did this work cheaper than the tractor. To effect any economy in such operations, a greater width of implements must be employed or a combination of two or more smaller implements must be drawn by one tractor. With horses the larger sized teams did field work at less cost than small teams especially for heavier operations like ploughing, disking and cultivating. While the cost per acre of working the land is somewhat cheaper with the tractor than with horses the chief advantage consists in covering a considerably greater acreage per day. This permits one man handling a much larger farm.

The Effect of Low Prices on the Cost of Certain Field Operations

The comparative costs in the preceding pages have been based on data representative of conditions in 1930 and the years immediately preceding. However, since that time farm wages, feed prices, fuel and oil have been greatly

reduced, making it advisable to show the effect of these changes. Assuming that manual labour is worth $1.50 per day instead of $2.50, horse labour 50 cents instead of 80 cents, and that tractor fuels are reduced from 26·6 to 21·6 cents per gallon and lubricating oils from $1.11 to ·91 per gallon, the following results are obtained.

TABLE 38—Comparative Costs per Acre in 1930 and 1931

Outfit	Ploughing		Cultivating	
	1930 costs	1931 costs	1930 costs	1931 costs
	$	$	$	$
4-horse team	1 27	0 77	0 43	0 27
6-horse team	1 52	0 94	0 44	0 27
8-horse team	1 17	0 72	0 44	0 27
2-plough tractors	1 23	0 99	0 33	0 27
3-plough tractor	0 98	0 80	0 35	0 29
4-plough tractor	0 89	0 74	0 38	0 31
Over 4-plough tractor	0 71	0 60	0 21	0 18

The effect of the low prices in 1931 has been to reduce materially the cost of doing field operations with horses. Costs with the tractor have also been reduced but not to the same extent as with the horses. However, even with the prices in 1931, the cost of performing field operations are very much the same with 2- and 3-plough tractors as with horses. Ploughing with the 2-plough tractor is much more expensive than with larger sized machines. This size is not being used extensively on the prairie. Large tractors, over 4-plough in size, have continued to operate at the smallest cost per acre. It should be observed that the use of horses involves less cash outlay than tractors.

Width of Tractor Implements Required to Utilize Capacity of Tractor

Many tractor owners who supplied information for this investigation were not covering a sufficient acreage per day with their tractor. Obviously some implements were being used which did not utilize the full capacity of the tractor. The following table is presented as a guide to the maximum width of implement that can be used with tractors of different sizes operated at ploughing speed. The average drawbar pull for each size of tractor is the average for each group as determined by dynamometer tests. For the 2-plough tractor the average drawbar pull is 1,166 pounds, for the 3-plough tractor 1,746 pounds, 4-plough tractor 2,443 pounds, and for the over 4-plough size of tractor over 3,000 pounds pull.

The draft of various implements is shown in the following table in pounds per foot of width. It is an average figure taken when the implements have been operated on medium loam soil. These figures will vary considerably depending upon the type and moisture content of the soil as well as the condition of the tractor and implement used. In case it is desired to haul after the tractor a combination of two or more small implements, the total draft may be calculated from the widths of the various implements used.

TABLE 39—Width of Tractor Implements

Required to Utilize Capacity of Tractor

Implement	Draft per foot of width (pounds)	Width of implements available	Maximum width for tractor			
			2-plough	3-plough	4-plough	Over 4-plough
			in.	in.	in.	in.
Mouldboard plough	492	Numerous widths...	28	42	56	70
		ft.	ft.	ft.	ft.	ft.
One way disk	160	6, 8, 9, 10	6·0	10·0	14·0	18·0
Cultivator	110	7, 8·5, 9·5, 11, 11·5	9·5	14·0	22·0	27·0
Single disk	60	18, 21, 24	18·0	24·0	39·0	48·0
Double disk	120	7, 8, 10	8·0	14·0	20·0	24·0
Drag harrow	40	.....	24·0	40·0	60·0	72·0
Rod weeder	100	9,12, 18	9·0	12·0	24·0	30·0
Seeder, double disk	60	14, 18, 20·5, 24·5, 28·5	18·0	24·5	41·0	49·0
Seeder, press drill	65	14, 18, 20·5, 24·5, 28·5	14·0	24·5	36·0	41·0
Packer	65	9, 12, 15, 17	17·0	27·0	34·0	45·0

Tractor Sales in the Prairie Provinces

In order to show the number of tractors sold in the three Prairie Provinces during the last thirteen years the following table is presented. This information was secured from distributors and factories selling tractors by "Canadian Farm Implements," Winnipeg. The enormous fluctuations in sales from year to year reflect to a considerable extent changes in the buying power of the country. Out of the total sales of 95,121 tractors during the last thirteen years, it is estimated that 82,000 are in operating condition. As there was a total of 248,162 farms in the three Prairie Provinces, according to the 1926 census, it will be seen that quite a substantial percentage of farmers own tractors.

TABLE 40—Tractor Sales in the Prairie Provinces

(Courtesy Canadian Farm Implements, Winnipeg)

Year	Manitoba	Saskatchewan	Alberta	Total
1919	3,627	3,514	1,703	8,844
1920	3,671	4,229	2,379	10,279
1921	1,057	1,655	716	3,428
1922	1,361	2,475	386	4,222
1923	911	2,524	731	4,166
1924	465	1,213	434	2,112
1925	1,008	2,176	869	4,053
1926	1,498	3,704	1,311	6,513
1927	1,414	5,727	2,885	10,026
1928	2,209	8,703	6,231	17,143
1929	2,423	6,906	5,228	14,557
1930	1,541	4,350	3,100	8,991
1931	186	267	334	787
Total	21,371	47,443	26,307	95,121

THE COST OF HARVESTING WHEAT WITH THE BINDER AND SEPARATOR AS COMPARED WITH THE COMBINE

In order to learn the relative cost of harvesting wheat by the usual method of cutting with the binder, stooking and stook-threshing as compared with the cost of harvesting with the combine, information was obtained by questionnaires from representative farmers throughout the three Prairie Provinces. Owing to the very rapid increase in the use of the combine, since its introduction in 1922 into the Prairie Provinces by the purchase of a machine on the Dominion Experimental Farm at Swift Current, it is very desirable to know the cost of harvesting wheat with the various methods.

In compiling these costs ordinary man-labour during harvest time has been charged at 40 cents an hour, or $4 per day including board, while tractor, separator, and combine operators have been figured at 50 cents an hour. If these rates do not apply to any special conditions which the reader may have in mind they may be changed, thereby altering somewhat the comparative costs of the various methods. Horse labour has been figured at 8 cents per hour; while the tractor, exclusive of the operator, has been charged at $9.87 per day. The 1930 price of gasolene was 26¼ cents per gallon, oil $1.11 per gallon, and grease 16 cents per pound. Interest has been charged at 7 per cent on one-half the original cost of the machinery while depreciation has been based on the estimated life of the various machines.

The Cost of Cutting Grain with Binders

The following table shows the cost of cutting grain with an 8-foot binder drawn by four horses, and with a 10-foot power-binder operated with a three-plough tractor. The daily costs as well as the cost per acre are presented.

TABLE 41.—Cost of Cutting Grain with Horse and Power Binders

Statement	Horse binder	Power binder
	$	$
Fixed charges—		
Cost of binder	290 00	375 00
Annual depreciation	23 20	37 50
Annual interest	10 15	13 10
Annual repairs	11 20	23 75
Total annual fixed charges	44 55	74 35
Acreage cut per day	18	32
Acreage cut per year	220	485
Number of days used	12·2	15·1
Amount of fixed charges per day	$ 3 65	$ 4 92
Amount of fixed charges per acre	0 20	0 15
Daily operating charges—		
Cost of man labour per day	4 00	5 00
Cost of horses or tractor	3 20	9 87
Cost of twine per day (3 pounds per acre at 15 cents per pound)	8 10	14 40
Total daily operating charges	15 30	29 27
Daily operating costs per acre	0 85	0 91
Total costs per day (fixed plus operating)	18 95	34 19
Total cost per acre (fixed plus operating)	1 05	1 07

The total cost of cutting grain, as will be seen from the above table, has been practically equal with both the horse-binder, at $1.05 per acre, and the power-binder at $1.07 per acre. The total cost per day, naturally, is very

The 4-horse team on an 8-foot binder cuts approximately 18 acres per ten-hour day while the power binder cuts 32 acres. The total costs per acre, however, are practically equal, being $1.05 and $1.07 per acre respectively.

much greater with the power-binder but the cost per acre is approximately equal owing to the much greater acreage cut per day. The acreage which would be cut per season would have an important effect on the amount of the fixed charges per acre. In these calculations the horse-binder has been assumed to cut 220 acres per season and the power-binder 485 acres. In order to cut 485 acres by means of 8-foot horse binders it would be necessary to use two binders. In this case the cost per acre would be reduced from $1.05 to $1.03.

The Cost of Stooking

The acreage stooked per day will vary with the individual stooker as well as with the crop. However, with a twenty-bushel crop of wheat one man might be expected to stook approximately 12 acres per day. With man labour at $4 per day, the cost of stooking would be 33 cents per acre.

The Cost of Threshing

The following table shows the cost of stook-threshing using a 28-inch separator and a crew of nine men and six teams:—

TABLE 42.—The Cost of Threshing

Statement	Amount
	$
Fixed charges—	
Cost of separator	1,470 00
Annual depreciation at 8 per cent	117 60
Annual interest	51 45
Annual repairs	29 00
Total annual fixed charges	198 05
Acreage threshed per day	46
Acreage threshed per season	485
Number of days used	10·5
Amount of fixed charges per day	$ 18 86
Amount of fixed charges per acre	$ 0 41
Daily operating charges—	$
Cost of manual labour per day (7 men at $4)	28 00
Cost of operators per day	10 00
Cost of tractor per day (without operator)	9 87
Cost of 6 teams of horses per day	9 60
Cost of separator lubrication and belt-lace per day	0 50
Total daily operating charges	57 97
Daily operating costs per acre	1 26
Total costs per day (fixed plus operation)	76 83
Total costs per acre (fixed plus operating)	1 67

The cost of stook-threshing wheat, as will be seen from the above table, was $76.83 per day or, on the basis of threshing 46 acres per day, $1.67 per acre. With a yield of 20 bushels of wheat per acre, and threshing 46 acres or 920 bushels per day, the cost of threshing would be 8·3 cents per bushel. These costs have been figured on a 28-inch separator and a crew of nine men and six teams. However, with larger sized outfits some reductions might be made in the costs provided larger acreages were available to thresh while, with smaller machines, the costs would be somewhat increased.

Total Cost of Binding, Stooking and Threshing

According to the figures previously presented the cost of cutting with the horse-binder, including the cost of the twine, was $1.03 per acre, the cost of stooking was 33 cents per acre, while the cost of threshing was $1.67 per acre. This makes, therefore, the total cost of harvesting $3.03 per acre, or with a yield of 20 bushels per acre 15·1 cents per bushel.

The Cost of Harvesting with the Combine

The following table gives the cost of harvesting wheat with a 15-foot combine drawn by a 3-plough tractor. It is estimated that 40 acres are harvested daily and 640 acres annually:—

TABLE 43.—Cost of Harvesting with the Combine

Statement	Amount
	$
Fixed charges—	
Cost of combine	2,300 00
Annual depreciation at 10 per cent	230 00
Annual interest	80 50
Annual repairs	69 00
Total annual fixed charges	379 50
Acreage harvested per day	40
Acreage harvested per year	640
Number of days used	16
Amount of fixed charges per day	$ 23 72
Amount of fixed charges per acre	$ 0 59
Daily operating charges—	$
Cost of tractor per day (without operator)	9 87
Cost of gasoline for combine motor per day	6 75
Cost of oil and grease for combine per day	1 70
Cost of two operators per day	10 00
Cost of team and man per day for hauling grain	5 60
Total daily operating charges	33 92
Daily operating costs per acre	0 85
Total costs per day (fixed plus operating)	57 64
Total cost per acre (fixed plus operating)	1 44

The cost of combining wheat, according to the above table, is $1.44 per acre. With a yield of 20 bushels to the acre this cost would amount to 7·2 cents per bushel. The cost per acre will vary somewhat depending upon the acreage harvested per year on account of the fact that the annual fixed charges remain almost the same irrespective of the acreage. Hence, if the total acreage harvested per year is 400 instead of 640 acres, the cost will be $1.80 instead of $1.44 per acre. Likewise if only 200 acres are combined the cost will rise to $2.75 per acre.

The cost of combining with horses, using ten on a 15-foot combine and harvesting 640 acres per season at the rate of 35 acres per day is $1.51 per acre, as compared with $1.44 when the combine is hauled by a tractor. These costs are calculated on the basis of horse labour at 8 cents per hour. If horse labour were charged at only 5 cents per hour, the cost of combining with horses drops to $1.40 per acre.

The Cost of Harvesting with the Swather and Pick-up

In some districts it is not advisable to harvest grain with the combine as described above, the method being modified by first swathing the crop and later, after it has dried sufficiently, lifting the swath off the stubble with a pick-up attachment on the combine. This method increases the cost somewhat by necessitating the purchase of additional equipment and adding the extra operation of swathing. Although a fairly large acreage can be swathed daily, the pick-up operation is reduced by about 10 acres per day below that of straight combining.

Estimating the cost of the swather to be $450, the total annual fixed charges including depreciation, interest, and repairs would be $75. Estimating the seasonal acreage at 640 acres this cost would be 12 cents per acre. The

daily operating charges for the tractor and operator amount to $15 per day or, on the basis of 50 acres swathed per day, would be 30 cents per acre. The total cost of swathing, therefore, would be 42 cents per acre.

The cost of harvesting with the pick-up attachment on the combine would be slightly increased owing to the fixed charges being increased and the acreage covered per day reduced from 40 acres with the straight combine to 30 acres with the pick-up. Estimating the cost of the pick-up attachment at $150 the fixed charges would be 62 cents and the operating charges $1.13 per acre or a total of $1.75 per acre. The total cost of harvesting with the swather and pick-up method would be, therefore, $2.17 per acre or 73 cents more than with the combine alone.

TABLE 44.—Comparative Cost of Harvesting Wheat per Acre with Different Methods

Acreage harvested	Combine (15-foot cut)	Swather and pick-up with combine	2—8 foot binders and 28-inch separator
	$	$	$
175	3 02	4 12	3 08
200	2 75	3 78	3 65
275	2 23	3 14	3 35
400	1 80	2 61	3 16
485	1 63	2 40	3 03
640	1 44	2 17	2 95

Crop Acreage Necessary to Justify the Purchase of a Combine

The combine method of harvesting wheat is undoubtedly the most economical if a sufficient crop acreage is available. Where this method can be successfully employed it is possible to materially reduce the cost of production. When 400 acres of crop are available, as will be seen from the above table, there is a saving, in comparison with the binder and separator method, of $1.36 per acre, while with larger acreages there are still greater economies. With smaller acreages, however, the superiority of the combine decreases. It is interesting to observe that even with 175 acres, the per acre harvesting cost with the size of combine as indicated above, is about equal to the binder and separator method, when binding and stooking are charged at $1.42 per acre and threshing at 8.3 cents per bushel. Below this acreage the binder and separator method would be more economical. As 175 crop acres would be available on a one-half section farm, this appears to be the minimum acreage to warrant the purchase of a combine. It is possible that with smaller acreages a 10 or 12-foot combine would be operated at less cost than the 15-foot combine on which the figures in the above table have been based. However, as will be seen on page 52 of this bulletin, it is doubtful whether the use of a tractor would be justified on a half-section farm. The combine could be hauled with horses or its use restricted to larger farms, the three-quarter section farm or larger, where the tractor would find more profitable use. Where conditions require the use of the swather and pick-up with the combine, the cost is so increased that approximately 275 acres of crop must be harvested in order to effect any economy over the binder and separator method.

In addition to the consideration of the relative costs of these methods there are certain other advantages of the combine which are difficult to evaluate accurately but which are not without importance. The combine leaves a long stubble which holds more snow during the winter and possibly leaves the soil somewhat moister in the spring. If stubble burning is desired, it can be done very

The combine has been the means of reducing the cost of producing wheat, particularly in times of labour scarcity and high wages. With 485 acres of a 20-bushel crop the cost of harvesting with a combine has been estimated at $1 63 per acre, with the swather and pick-up attachment on the combine at $2 40 per acre, while with the binder and separator method the cost was $3 63 per acre

satisfactorily. Finally, as this method requires fewer men, there is less trouble in providing meals. On the other hand, many farmers already possess binders and threshing machines which may have to be used for several years before they can be discarded without considerable loss.

TABLE 45.—Comparative Cost of Harvesting Wheat per Bushel with Different Methods
(Based on 485 acres of crop with varying yields per acre)

Crop yield, bushels per acre	Combine (15-foot cut)	Swather and pick-up with combine	2—8 foot binders and 28-inch separator
	cents	cents	cents
5	32·6	.....	.....
10	16·3	24·0	30·3
15	10·9	16·0	20·2
20	8·2	12·0	15·1
25	6·5	9·6	12·1
30	5·4	8·0	10·1
35	4·6	6·8	8·7
40	4·1	6·0	7·6
45	3·6	5·3	6·7

The cost of harvesting wheat per bushel varies considerably with the yield per acre. Irrespective of the method of harvesting the cost per bushel becomes less with heavier yields. With light yields the combine method shows a decided advantage over the other methods. In fact when the yield drops to around five bushels per acre it is difficult to employ the swather and pick-up on account of the sparse stubble on which to lay the swath. The binder also is not very satisfactory for such low yields while the charges for threshing are greater. With the exception of the combine the only other successful method for extremely light yields is the header method. With a 20 bushel yield per acre the saving accomplished by the combine over the binder and separator method is 6.9 cents per bushel. With smaller yields, as will be seen from the above table, the saving is greater while with heavier yields it is less.

THE NORMAL DAY'S FARM WORK

The purpose of this chapter is to make available information concerning the average day's work for men, horses, tractors and various farm implements in doing different field operations. The information was secured in 1929 by the questionnaire method from 1,006 representative farmers in the Prairie Provinces.

The following tables show the average acreages covered per ten-hour day by the farmers who contributed information to this investigation. The number of reports of the different sized outfits listed under each operation indicates their relative popularity. Simple rules for calculating the acreages which may be covered per ten-hour day with any size of implement will be found on page 77 of this bulletin, but the following tables give the actual average acreage done per day by hundreds of representative farmers in the three Prairie Provinces.

TABLE 46.—Acres Ploughed per 10-Hour Day

Implement	Width in inches	Power used	Acres per day			
			Ploughing sod		Ploughing stubble	
			Number of reports	Number of acres	Number of reports	Number of acres
One-furrow plough	14	4 horses	74	1·9	.....	.....
		5 "	50	2·3	.....	.....
		6 "	29	2·6	.....	.....
	16	4 horses	82	2·0	.....	.....
		5 "	70	2·2	.....	.....
		6 "	43	2·5	.....	.....
	20	8 "	19	3·3	.....	.....
Two-furrow plough	12	4 horses	.....	.....	134	4·2
		5 "	.....	.....	61	4·3
		6 "	.....	.....	39	4·6
	14	4 "	.....	.....	110	4·5
		6 "	8	3·6	169	4·8
		8 "	12	4·6	.....	.....
		Tractor	27	5·7	35	8·0
Three-furrow plough	12	5 horses	.....	.....	5	5·4
		6 "	.....	.....	8	6·5
	14	5 "	.....	.....	4	5·1
		6 "	.....	.....	17	6·5
		8 "	.....	.....	83	7·6
		Tractor	140	7·5	205	11·9
Three-disk plough	.....	"	.....	.....	19	9·9
Four-furrow plough	.....	Tractor	26	8·7	52	14·7
Four disk plough	.....	"	17	7·0	20	10·8
One-way disk plough	5·6 ft.	8 horses	.....	.....	1	10
	10	Tractor	.....	.....	4	30
	6	"	.....	.....	1	20

Forty per cent of the men using horses for ploughing employed 4-horse teams. Thirty per cent used 6-horse teams, nineteen per cent 5-horse and eleven per cent 8-horse teams.

The majority of the tractors pulled three and four-furrow ploughs while some were used with disk ploughs and one-way disks.

TABLE 47.—Land Preparation and Seeding with Horses—Acres per 10-Hour Day

Operation	Average width in feet	Number of horses	Number of reports	Acres per day
Cultivating	7·6	4	268	13·1
	8·7	6	364	16·5
	9·9	8	45	20·1
Single disking	7·7	4	439	13·7
	12·0	6	106	20·3
	14·0	8	46	30·5
Double disking	7·5	4	104	8·2
	7·7	6	153	14·9
	8·8	8	81	16·8
Drag harrowing	18·4	4	341	31·8
	20·5	6	334	42·5
	25·0	8	15	63·0
Rod weeding	12·0	6	8	23·0
	12·0	8	3	28·0
Packing	12·5	4	287	25·4
	13·7	6	61	28·6
	22·0	8	2	50·0
Seeding	9·9	4	644	19·2
	11·5	6	177	25·4
	12·2	8	7	33·5

Substantially larger acreages are covered per day by the use of wider implements and proportionately larger teams. The 4-horse teams are used most frequently for single disking, drag-harrowing, packing and seeding. For cultivating, double disking and rod weeding, the 6-horse teams are used most commonly. Only about six per cent of the operators reported the use of 8-horse teams for these operations.

Owing to the wide variations in the width of the various implements used, the average width has been presented in the above table.

TABLE 48.—Land Preparation and Seeding with Tractors—Acres per 10-Hour Day

Operation	Average width in feet	Size of tractor	Number of reports	Acres per day
Cultivating	8·4	2-plough	17	25·8
	10·9	3 "	86	33·5
	11·4	4 "	44	36·5
Single disking	11·4	2-plough	7	26·4
	14·4	3 "	79	50·1
	18·8	4 "	45	60·0
Double disking	8·0	2-plough	20	22·5
	9·4	3 "	99	29·3
	12·3	4 "	14	35·4
Drag harrowing	19·2	2-plough	20	60·3
	27·3	3 "	30	91·5
	32·5	4 "	91	115·7
Rod weeding	12·0	3-plough	3	40·0
	12·0	4 "	1	50·0
Packing	14·4	2-plough	5	39·0
	19·1	3 "	11	67·7
	24·4	4 "	8	80·6
Seeding	11·9	2-plough	15	30·1
	12·2	3 "	51	43·7
	14·0	4 "	22	54·7

By comparing the acreages in the above table with those in the preceding table, it is quite evident that much greater acreages are handled per day with tractors than with horses. Approximately 54 per cent of the tractors used for these operations were 3-plough machines. The larger sized tractors covered considerably greater acreages per day than the smaller sizes.

Seed bed preparation or summerfallow can be done at the rate of 25 acres per day with this 11½-foot cultivator.

TABLE 49.—Cutting Grain—Acres per 10-Hour Day

—	Horse operated				Tractor operated			
	Average size in feet	Number of horses	Number of reports	Acres per day	Average size in feet	Size of tractor	Number of reports	Acres per day
Binding	6·0	3	11	10·6	8·5	2-plough	22	23·4
	7·6	4	806	16·4	10·2	3-plough	66	31·6
					10·7	4-plough	21	35·5

TABLE 50.—Stooking—Acres per Man per 10-Hour Day

Grain	Acres per man per day	Yield per acre	Number of reports
Wheat	11·8	25·6	802
Oats	12·1	49·2	810
Barley	12·3	33·7	546

TABLE 51.—Threshing Grain—Capacity per 10-Hour Day

Cylinder width in inches	Average size of crew		Number of reports	Acres cleared per day			Bushels threshed per day		
	Men	Stook teams		Wheat	Barley	Oats	Wheat	Oats	Barley
22	6·0	4·0	150	26·0	30·7	30·3	678	1,363	1,011
24	7·4	5·1	80	33·6	38·8	36·5	943	1,834	1,248
28	8·8	6·0	247	38·8	44·1	43·4	1,056	2,094	1,560
32	11·5	7·5	46	44·8	51·4	50·1	1,207	2,451	1,720
36	13·8	8·2	19	59·7	62·4	61·1	1,572	3,120	2,320
40	16·3	8·1	9	66·4	74·0	70·0	1,915	3,400	2,716

TABLE 52.—Harvesting Grain with Combined Reaper-Thresher—Acres per 10-Hour Day

Size of combine in feet	Size of tractor	Number of reports	Acres per day
11·5	2-plough	8	32·5
14·7	3-plough	109	39·3
15·4	4-plough	73	43·6

TABLE 53.—Harvesting Grain with Swather and Pick-up—Acres per 10-Hour Day

Width of cut in feet	Number of reports	Acres swathed per day	Acres harvested per day
12	14	39·6	25·6
16	37	51·7	30·5
20	5	61·2	39·2

Hauling Wheat

The number of bushels of wheat hauled per day depends largely on the condition of the roads. the size of the loads, and the time required for loading and unloading. Overloading motor trucks, it is interesting to observe, is the general rule, the overloading being relatively greater with the smaller sized trucks. Thus the one-ton trucks carried an average load of 65·2 bushels of wheat, or 3,913 pounds, the one and one-half-ton truck carried 88 bushels or 5,280 pounds, while the two-ton truck carried 92 bushels or 5,520 pounds.

TABLE 54.—Hauling Wheat—Capacity per 10-Hour Day
Hauling with Horses

Distance hauled, miles	Number of reports	Number of men	Number of horses	Bushels hauled per day
1	15	1	2	570
	3	1	4	701
2	52	1	2	340
	6	1	3	500
	11	1	4	545
3	112	1	2	269
	15	1	3	353
	21	1	4	392
4	57	1	2	187
	4	1	3	225
	9	1	4	312
5	62	1	2	152
	29	1	4	248
6	24	1	2	127
	23	1	4	235
7	32	1	2	109
	22	1	4	180

TABLE 55.—Hauling with Motor Truck

Distance hauled, miles	Number of trips	Number of reports	Bushels hauled per day		
			1-ton trucks	1½-ton trucks	2-ton trucks
2·0	18	10	1,173	1,584	1,656
3·0	13	13	847	1,144	1,196
4·6	10	19	652	880	920
5·5	9	1	586	792	828
6·3	8	14	521	704	736
7·4	7	9	456	616	644
8·6	6	15	391	528	522
11·0	5	9	326	440	460
14·0	4	11	260	352	361
18·6	3	8	195	265	276
26·0	2	3	130	176	184

TABLE 56.—Mowing Hay—Average Cut per 10-Hour Day

Number of horses	Number of reports	Width of cut in feet	Acres cut per day
2	23	4·5	8·3
2	305	5·0	9·0
2	20	6·0	9·6

TABLE 57.—Raking into Windrows—Average per 10-Hour Day

Number of horses	Number of reports	Acres per day
2	311	18·4

TABLE 58.—Loading—Hauling and Unloading Hay
Capacity per 10-Hour Day

Number of men	Number of horses	Number of reports	Number acres per day	Number tons per day
2	2	89	6·7	8·3
3	4	48	8·2	12·5
4	4	21	10·0	16·3
4	6	22	12·0	18·5

The following table shows the average acreage under cultivation as well as the number of horses per farm on farms where no tractor was owned. These farms constitute 54·3 per cent of the total number of farms.

TABLE 59.—Size of Farms and Number of Horses per Farm

Average cultivated acreage	Number of reports	Number of horses per farm
117	125	5·7
255	234	8·2
404	102	10·7
578	52	13·0
792	30	16·3
1,154	4	22·0

MISCELLANEOUS INFORMATION

TABLE 60—Number and Size of Farms in the Prairie Provinces (1926 Census)

Province	Total number of farms	Total acres per farm	Improved acres per farm	Crop acres per farm
Manitoba	53,251	271	157	118
Saskatchewan	117,781	390	253	166
Alberta	77,130	370	171	119

TABLE 61.—Average Yield of Wheat in Exporting and Importing Countries

Country	Period of years	Average yield per acre
		bush.
Exporting—		
Canada	25	17·8
United States	25	14·5
Australia	25	12·6
India	23	11·3
Argentine	24	11·1
Russia	19	10·1
Importing—		
Great Britain	25	33·9
Germany	25	28·6
France	25	19·7
Italy	23	16·1

TABLE 62.—Annual Yield and Price of Wheat in the Prairie Provinces from 1910 to 1931
(Canada Year Book)

Year	Bushels per acre			Average price per bushel
	Manitoba	Saskatchewan	Alberta	
				$
1910	12·4	15·8	10·3	0·72
1911	22·6	20·7	22·3	0 61
1912	22·2	19·2	21·6	0 59
1913	19·0	21·2	22·7	0 65
1914	14·8	13·7	21·0	1 13
1915	24·7	25·1	32·8	0 90
1916	10·9	16·3	25·0	1 28
1917	16·7	14·2	18·2	1 91
1918	16·3	10·0	6·0	1 99
1919	14·2	8·5	8·0	2 34
1920	13·9	11·2	20·5	1 63
1921	11·1	13·7	10·3	0 81
1922	19·2	20·2	11·2	0 82
1923	12·3	21·3	28·0	0 66
1924	16·9	10·2	11·0	1 22
1925	17·8	18·5	18·0	1 12
1926	22·6	16·2	18·5	1 07
1927	14·0	19·5	27·4	1 00
1928	19·7	23·3	25·5	0 81
1929	13·7	10·7	12·0	1 05
1930	18·3	13·7	18·6	0 44
1931	10·5	7·9	16·9	0 38
Average 22 years	16·5	16·0	18·4	1 05

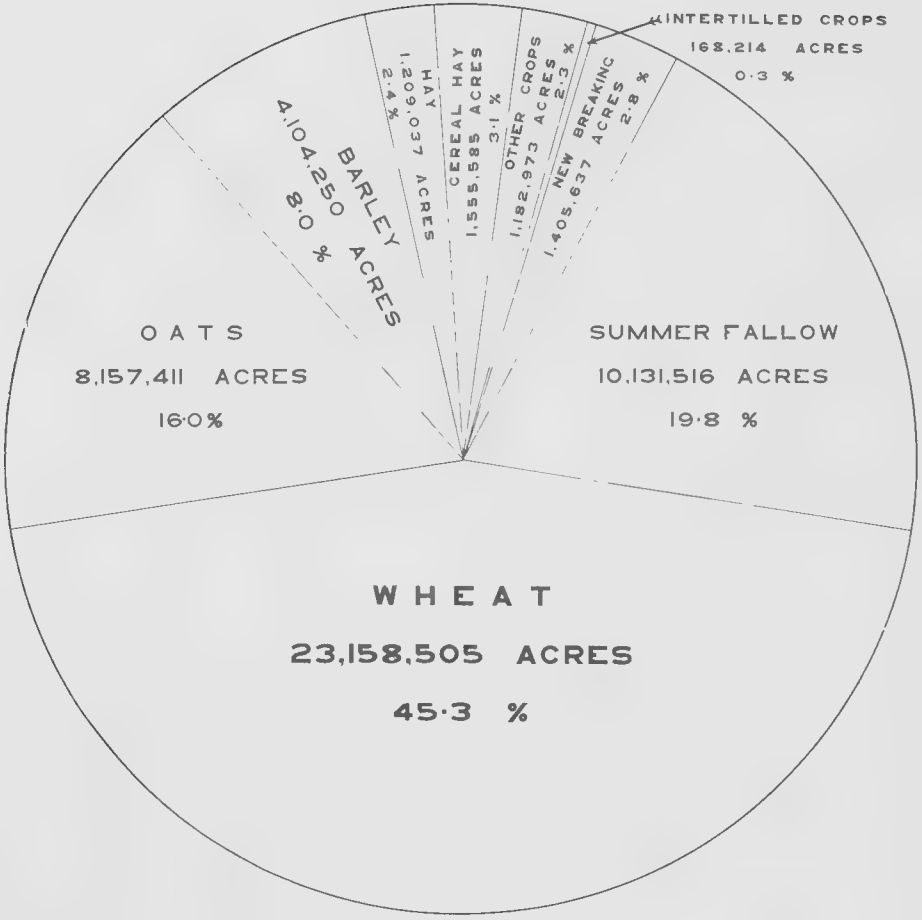
The prices presented above are the average of the three Prairie Provinces as given by crop correspondents at the point of production. The figures would approximate very closely the local prices in Saskatchewan.

The average yields of wheat in Kansas and North Dakota, over a period of 23 years from 1907 to 1930, according to the United States Year Book, were 13·3 bushels per acre in Kansas and 10·9 bushels in North Dakota.

TABLE 63.—Variations in Annual Gross Returns per Acre from Wheat on the Dominion Experimental Farm, Indian Head, Saskatchewan—Average Yields from Three-year Rotation of Summer-fallow, Wheat, Wheat

Year	Yield per acre	Price per bushel	Gross returns per acre
	bush.	$	$
1912	20·7	0 59	12 21
1913	32·5	0 65	21 12
1914	20·1	1 13	22 71
1915	22 3	0 90	20 07
1916	21·3	1 28	27 26
1917	25·5	1 91	48 70
1918	19·6	1 99	39 00
1919	19·6	2 34	45 86
1920	21·1	1 63	34 39
1921	27·8	0 81	22 52
1922	26·5	0 82	21 73
1923	16·3	0 66	10 76
1924	17·7	1 22	21 59
1925	27·1	1 12	30 35
1926	28·1	1 07	30 07
1927	25·9	1 00	25 90
1928	26·1	0 81	21 14
1929	9·0	1 05	9 45
1930	23·6	0 44	10 38
1931	5·7	0 38	2 17
Average for 20 years	21·8	1 09	23 76

ACRES UNDER CULTIVATION
IN 1928 IN
MAN. SASK. & ALTA.
51,118,128 ACRES



COST OF SHIPPING WHEAT TO LIVERPOOL*

Approximate average charges between the producer in Western Canada and the arrival of steamer at Liverpool docks per bushel of wheat—1930 season:

	Per bushel Cents
1. Receiving at country elevator, weighing, elevating, spouting, insurance against loss by fire and storing for fifteen days, loading into cars for shipments, cost of inspection and weighing, Lake Shippers' and Government registration fees and selling to exporter on Winnipeg market	5
2. Railway freight rate from average western point to Fort William-Port Arthur terminal elevators	13¹
3. Unloading at terminal elevator Fort William-Port Arthur, elevating, weighing, cleaning, spouting, insurance against loss by fire and storing for fifteen days and loading into vessel or cars for shipment (including outward inspection and weighing fees, Lake Shippers' and Government registration fees and marine insurance)	2
4. Lake freight rate from Fort William-Port Arthur to Montreal (including trimming charges, out-turn insurance, and transfer charges at Port Colborne—if transferred to smaller craft through the Government elevator)	8½
5. Elevation of grain from steamer at Montreal, weighing, storage and insurance against loss by fire or explosion for 10 days and loading into ocean steamers (including brokers' fees)	1
Total charges for all services between producer and f.o.b. steamer at Montreal, per bushel of wheat	30
6. Approximate average cost of freight and insurance. Montreal to Liverpool, 1930 season, per bushel of wheat	4½
Total costs between producer and Liverpool dock—per bushel of wheat	34½

* E. A. Ursell, Statistician, Board of Grain Commissioners for Canada, Fort William, Ont.

SUMMARY

The cost of producing wheat on eight Dominion Experimental Farms in the Prairie Provinces over a period of eight years from 1923 to 1930, was 64 cents per bushel on summer-fallow land and 75 cents on land two years after the summer-fallow. The average cost, therefore, for the two wheat crops was 69 cents per bushel to which would have to be added the cost of hauling from the farm to the elevator. The average return value during this period was 93 cents per bushel. The cost of production per acre on summer-fallow land was $17.40 with an average yield of 27·4 bushels, while the second crop cost $14.95 with a yield of 19·8 bushels per acre.

On 31 Dominion Illustration Stations in Manitoba, Saskatchewan and Alberta, the cost of producing wheat on summer-fallow was $14.53 per acre or, considering the yield of 23·2 bushels per acre, was 63 cents per bushel. As second crop after summer-fallow, on 22 Illustration Stations, the average cost was $12.39 per acre or, with the yield of 16·2 bushels was 76 cents per bushel. In addition to these costs, there would be an additional charge for hauling to the elevator.

In 1929 a survey was made of a number of private farms in the Prairie Provinces in regard to learning improved methods of operation and the cost of producing wheat. The average cost on 13 of these farms for this one year on summer-fallow land was $17.50 per acre. With an average yield of 22·3 bushels per acre the cost per bushel was 78 cents. Wheat after wheat cost $13.62 per acre but as the average yield was only 12·2 bushels per acre the cost was $1.12

per bushel. As would be expected wide variations existed from one farm to another, one farm producing wheat on summer-fallow land at the small cost of 53 cents per bushel while on another the cost was $1.46 per bushel.

The cost of producing hay on eight Dominion Experimental Farms, over a period of eight years, was $8.99 per acre. The yield varied widely from year to year, averaging 1·44 tons per acre. Oat hay, on one farm, gave an average yield of 2·13 tons at a cost of $10.06 per acre. Corn for silage, with a yield of 6·05 tons, cost $23.21 per acre. Sunflowers for silage yielded 10·29 tons and cost $27.95 per acre. Turnips on one farm yielded 15·29 tons at a cost of $34.71 per acre while potatoes cost $65.47 with a yield of 239·2 bushels per acre.

Outlines are presented in one chapter of this bulletin, entitled "Farm Budgets for Economical Wheat Production," showing the probable expenses and anticipated revenue from various sized grain farms. These "set-up" outlines have been prepared in the main from information drawn from other chapters of the bulletin and represent what results might be expected from operating various sized grain farms according to different methods. The calculations are subject to modifications depending upon local conditions in different districts but undoubtedly indicate the effect of size of farm and method of operation on the cost of production and total net revenue.

The size of the farm is undoubtedly an important factor in profitable grain production. The one-quarter section farm seems entirely too small for this purpose, the reason being that the overhead costs for equipment and labour are altogether too high while the revenue obtained is much too small. The cost of producing wheat on such a farm, with an average yield of 18 bushels per acre, would be approximately $1.02 per bushel. Unless the yield was considerably greater or the price higher there could be no satisfactory outlook for a grain farm of this size. Being too small to employ a tractor, combine or other labour-saving equipment, it would be obliged to produce its grain at a high cost and would bring in only a very small gross revenue. Such a farm should not be operated as a purely grain proposition. It should not entail excessive costs by purchasing expensive labour-saving equipment, but should include such other lines as cattle, hogs and poultry which would provide an opportunity for more labour and would create a larger gross and net revenue.

A half-section grain farm when operated by one man and seven horses would be able to produce wheat at 79·5 cents per bushel while, when operated with a 10-h.p. tractor and two horses, the cost would be increased to 85 cents per bushel. A comparison was made of four different methods of operating a section comparing horse operation, tractor, horse and tractor, threshing hired and harvesting done with the combine. Operation with a tractor and a combine effected the greatest economy reducing the cost of producing wheat to 63·6 cents per bushel. Further calculations are presented for two and three-section farms showing how the cost of production might be reduced to as low as 55·4 and 51·1 cents per bushel, respectively. Such costs would seem to represent the very lowest possible charges on $40 acre land and 18 bushel average yields. The outlines show what economy may be expected by the most effective use of land and labour saving equipment. While larger average yields would be secured in more favourable districts there is always the risk even in the best areas of two or three consecutive crop failures. With such a heavy investment and operating cost, considerable reserve capital would be necessary.

The ownership of a farm in the Prairie Provinces of Canada involves a heavy capital investment. The amount of this investment depends on the size of the farm and the value of the land. If the land is valued at $40 an acre, a one-half section farm involves an investment for land alone of $12,800 while

larger farms will be proportionately greater. In addition to this investment in land there is also a large investment in equipment. Obviously with the heavy interest, taxes and operating charges on such a farm, a large gross as well as net revenue must be obtained if the enterprise is to be a success. The farm is no longer a self-sufficing property requiring merely that the operator feed his family. It is a business requiring the production of sufficient revenue to pay the heavy annual expenses incurred in its operation.

The use of labour-saving machinery is an extremely important factor in reducing the cost of production per acre as well as making possible a much larger acreage being handled per man. A remarkable change has occurred in recent years in the equipment available for grain production. The tractor has been improved to such an extent that it is now a reliable and economical method of supplying power. It would seem necessary in most cases to operate at least and preferably more than one-half section of land, however, in order to have sufficient work available for the tractor. For quarter and half section farms, horses appear to be more economical. A 4-plough tractor, ploughing 15·7 acres a day, covers three times as much as a 6-horse team and twice that of an 8-horse team. For heavier operations like ploughing, disking and cultivating, the tractor effects considerable saving over horses, but for lighter work there is not much difference in cost. The chief advantage consists in covering a considerably greater acreage per ten-hour day thus permitting one man to handle a much larger farm. During rush seasons the tractor may be operated during the night thereby still further adding to its advantage.

The introduction during the last ten years of the combined reaper-thresher has made available another machine which on the larger sized farms has made possible a considerable reduction in the cost of growing wheat. With a yield of 20 bushels per acre, and 485 acres in crop, it is estimated that the combine will save 6·9 cents per bushel over the binder and separator method. With light yields, such as 10 bushels per acre, as will be seen by referring to page 65 of this bulletin, the combine will save 14 cents a bushel. Obviously where there is only a small margin of profit, the use of the combine may make all the difference between profit and loss. An area of 175 crop acres, such as would ordinarily be found on a half-section farm would seem to be the minimum size which would justify the purchase of a combine and probably a three-quarter section unit would be safer.

In addition to the tractor and the combine, other labour saving machinery has been introduced. These developments have resulted from an insistent demand for larger machines to utilize the full power of tractors and large teams of horses. Wide cultivators, disks and seeders make it possible to cover much larger acreages per day. The one-way disk which performs a job about half-way between that of an ordinary disk and a plough, makes possible very rapid handling of the land and seems to be a very popular and useful implement.

The most important factor, perhaps, in reducing the cost of production is to secure larger yields per acre. Most of the items of expense incurred in growing a crop are the same whether the crop be small or large while only a few items vary directly with the yield. The expenses for rent or use of the land, taxes, preparation of the soil, seed, seeding, machinery and most of the harvesting costs are the same irrespective of the yield. It is clear gain, therefore, to secure as large yields as are economically possible. While it is true that the weather, and especially the rainfall, plays a very dominant part in producing good yields and that no human control is possible over it, nevertheless, there are many other ways of increasing yields.

All better farming practices which have been shown by experiment or experience to give larger yields should be followed. The neglect of only one practice may cause a poor yield even though every other procedure had been

done in the best possible way. It is apparent that good seed of suitable varieties should be used, effective cultivation of the land practised, suitable rotations followed including legumes where desirable, and weeds, insects and fungous diseases effectively controlled. Within the last five years experiments have shown that certain commercial fertilizers, especially phosphorus, have produced in certain districts remarkable increases in crop yields. These experiments have proved that applications must be made in the row with the grain and not broadcast on the surface of the land. By such a method of application much smaller and therefore more economical rates of application are possible. Besides a much more effective control of weeds is accomplished, the weeds between the rows being dwarfed by the rank growth of the fertilized grain. When it is considered that increases up to 10 bushels of wheat per acre have been secured in certain districts from small applications of fertilizers it will be evident that this offers a very promising means of materially reducing the cost of production per bushel. It is very doubtful whether any agricultural discovery in recent years offers as much promise of increasing yields and decreasing costs of production as does the intelligent use of commercial fertilizers in certain districts. The experiments conducted by the Dominion Experimental Farms and Agricultural Colleges throughout the Prairie Provinces afford a reliable source of information as to the value of these materials in various districts as well as information on other methods of increasing crop yields.

Experience has proved the necessity of maintaining a reserve of feed for periods of adverse conditions. Sufficient seed and operating capital should also be reserved, if at all possible, to carry over two or three successive bad years.

Owing to the uncertain and variable character of the returns from farming, it is imperative that considerable savings should be carried over from good years to poor years or years of low prices. Crop yields are very variable irrespective of the treatment; in fact, good methods are more likely to give exceptionally heavy yields in favourable seasons than to prevent crop failure in bad years. Bad years may be caused by so many factors that it is always wise to be prepared. While the Canadian prairie enjoys a larger average yield of wheat than any other important wheat-exporting country in the world, it is subject to poor as well as good yields. Drought, rust, frost, hail, insect pests and soil drifting

may seriously lower the yield. Poor harvesting weather may impair the grade. In order to show the variable character of wheat yields even on well summer-fallowed land a graph is presented on page 27 showing the yields per acre from 1912 to 1930 on the Dominion Experimental Farm at Lethbridge, Alta. From this table it will be seen that the yield of wheat has varied from 2·2 bushels per acre in 1919 to 63·1 bushels in 1915. To show the variable character of wheat prices, a table is presented on page 71 giving the local prices in the three prairie provinces from 1910 to 1931. The prices have ranged, it will be seen, from $2.34 per bushel in 1919 to 38 cents per bushel in 1931. Obviously with such varying yields and prices, the only safe course to follow, if it is at all possible, is to lay aside sufficient money, seed and feed to carry over two or three successive bad years. It is very risky and unwise to expand unduly after a period of good years. By keeping a set of accounts, taking an annual inventory, making a plan of the farm each year showing the cropping system followed and the yields secured, it is possible to plan the farm business more successfully.

WEIGHTS AND MEASURES

SIMPLE RULES FOR CALCULATING ACREAGES

As a guide in calculating what acreage should be covered by various machines per day the following rules may be employed. One simple rule consists in multiplying the width in feet by the rate of travel in miles per hour. For example, if the machine were 8 feet wide and travelled two miles per hour it would cover 16 acres per ten-hour day. Actually, it should cover 19·4 acres per ten-hour day, but the figure of 16 acres would perhaps account for stops and turning. Another rule consists in multiplying the width of the machine in inches by the rate of travel in miles per hour, by the number of hours worked, and then dividing by 100. For example, if the machine were 28 inches wide and travelled two miles per hour for ten hours it would cover 5·6 acres. After any operation has been completed, the acreage may be calculated easily on the basis that one rod in width, or 16·5 feet, by one-half mile in length, 160 rods equal one acre: One acre contains 160 square rods, 4,840 square yards or 43,560 square feet.

Weights of Agricultural Commodities

Pounds per Measured Bushel

Grains—	Pounds
Barley	48
Beans	60
Buckwheat	48
Corn (grain)	56
Corn (cob)	70
Oats	34
Peas	60
Rye	56
Wheat	60
Grasses—	
Brome grass	14
Canada blue grass	14
Kentucky blue grass	14
Meadow fescue	22
Orchard grass	14
Red top (in chaff)	14
Red top (chaff free)	30
Timothy	48
Western rye grass	14

Alfalfa and clovers—	Pounds	
Alfalfa	60	
Alsike clover	60	
Red or Mammoth clover	60	
Sweet clover	60	
White Dutch clover	60	
Other seeds—		
Flax	56	
Hemp	44	
Potatoes (tubers)	60	
Sunflowers	24	
Other measurements—		
1 bag potatoes	90	net
1 barrel of potatoes	165	"
1 barrel of potatoes	180	gr.
1 barrel of flour	196	net
1 bushel of mangels	50	"
1 bushel of turnips	50	"

ESTIMATING GRAIN IN A BIN

To estimate the number of bushels of grain in a rectangular bin, take the measurements of the length, width and height of the grain in the bin. Obtain the total number of cubic feet of grain and then divide this by 1·25 to find the number of bushels.

In order to estimate the number of bushels of grain in a round granary, square the diameter of the granary in feet and multiply by 0·7854. Then multiply by the depth of the grain in feet and divide by 1·25.

ESTIMATING WEIGHT OF HAY IN STACKS

There is no accurate method of finding the weight of hay in a stack except by weighing it, but a number of methods are used for estimating it. All methods are designed to get as accurately as possible the number of cubic feet in the stack. This is then divided by the number of cubic feet per ton of hay. The same principle is followed in estimating the hay in a barn. The volume of hay is found and this is divided by the cubic feet per ton.

To estimate the volume or number of cubic feet of hay in a stack the procedure is to find the length and width of the stack and measure the distance over the stack from the ground on one side to the ground on the other side. This last measurement is found by throwing a rope over the stack. These three measurements are multiplied together and from one-quarter to one-third of this product will give the number of cubic feet in the stack. If the stack is so built that it slants toward the top from close to the bottom of the stack, one-fourth of the product is taken; if the stack goes up perpendicular or straight for about half its height and then slopes toward the top, one-third of the product is taken.

The most difficult problem is to estimate the number of cubic feet of hay required to equal one ton. Rules vary widely in different localities. One rule states that when hay has stood less than one month it requires 580 cubic feet of hay to make a ton; when it has stood one month, 512 cubic feet; five or six months, 422 cubic feet; and when it has stood one year, 343 cubic feet. If it is at all possible, it is very much more accurate to weigh the hay or at least to weigh one stack before estimating the weight of similar stacks.

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